ENERGY

Regional Economic Indicators Analysis

Final Report

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1.0 INTRODUCTION

Physicist John Wheeler, commenting on recent discoveries in particle physics, stated that "we make the world by the questions we ask." One never sees a quark, for instance. Only after the development of a theory that such a particle might exist can questions be asked and experiments be designed to produce the evidence of the particle's existence. Without ever meeting the quark, scientists can use the evidence of its existence and turn it into advances in computer technology, medicine and communication equipment design.

Similar to the developments in particle theory, the dramatic shift of the role energy plays in the economy -- no longer a mere feedstock into manufacturing output or a home heating requirement, but a fundamental influence upon interest rates, inflation and employment -- suggests that a new framework of understanding must be established on how energy use affects the economic development opportunities in the next decade and beyond. Decisionmaking models suitable for industrial age thinking must give way to an information age which demands new economic constructs and a new understanding of the constraints imposed by and opportunities which inhere to resource utilization.

In today's highly volatile economy it is not enough to assert that the goal of a national energy policy is to assure adequate energy supplies at a reasonable cost and to expect that such a policy automatically will assist in the creation of new jobs and new community development opportunities. Rather, we must ask specific questions such as how can energy consumption patterns be shaped to produce new employment? Or, how can energy management strategies be designed to give communities more control over their development opportunities? In short, providing adequate energy supplies can no longer be seen as a goal. It is the efficient use and management of energy resources in a way that enhances the economic well-being of our communities and the nation which must be seen as the goal.

This larger view of energy dictates that energy professionals and decisionmakers absolutely be informed on the very substance of how resource utilization impacts employment, income shifts and community development. Energy as the invisible economic factor in our lives can only be profitably acted upon when it is made visible through sound economic analysis. With this perspective in mind, this report attempts to set out the fundamental relationships of energy production and consumption to the economic development and employment patterns in the states of Iowa, Kansas, Missouri and Nebraska.

The intent is to offer state and local policymakers a reference of complete energy data and analytical tools to assist them in the difficult task of designing well-reasoned energy policies. The intent is not to provide the means to predict but to positively shape the economic future of the four states through the implementation of effective energy management strategies.

The report was funded by a technical assistance grant from the Kansas City Support Office of the Department of Energy through monies made available by the Energy Policy and Conservation Act. It is hoped that the information and the tools produced in this report will support strategies that lead to energy savings which sustain the larger goal of economic development and employment opportunities. Serving as economic consultants to this study were Donald W. Macke and Mary Fejfar, both of Lincoln. Acting as an advisory panel to this cooperative venture were: Ronald J. Brown and Jack Stacy, Kansas City Support Office; Larry Bean, Iowa Energy Policy Council; Al Pasini, Missouri Department of Energy; and Phil Dubach, Kansas Corporation Commission.

While greatly assisted by staff from Kansas City and the Energy Offices in Iowa, Kansas and Missouri, the accuracy of the report and its editorial content remain the sole responsibility of the Nebraska Energy Office. Questions and discussion are encouraged, however. Persons wishing more information regarding the work should contact either Kandra Hahn, Director of the Nebraska Energy Office who served as chairperson of the project advisory committee, or Skip Laitner, Chief of the Strategic Conservation Division of the Nebraska Energy Office who acted as the project coordinator of the study.

Skip Laitner
March, 1985

2.0 ENERGY EFFICIENCY: TOWARDS A NEW PERSPECTIVE

Since the backlash resulting from the 1973-74 Arab Oil Embargo, this country's economic response has been characterized largely by crisis management. The weatherization programs that are administered, the present research and development programs underway and the emergency plans which now shelve the libraries of state energy offices, were all born in crisis.

As we enter the second decade of energy policy, struggling to develop a coherent philosophy and understanding of resource consumption and its impacts, fundamental assumptions which underpin energy programs must undergo a rigorous re-examination if we are to capture the opportunities which inhere to efficient management of the nation's resources. New pillars of energy policy should be erected, ones that:

- Incorporate the very real possibility of resource constraints into future development plans, whether they result from political and economic conditions or physical shortages.

- Emphasize the design of efficiency programs to pursue economic opportunity rather than ones which respond only to crisis thinking.

- Reintroduce the community as the focus of energy management efforts. A community is not only the basic unit of economic activity, but it is also the fundamental unit of decisionmaking in a democratic society.

- Reject the notion that increased expenditures and consumption of resources are sound economic solutions. Such thinking must give way to better management and improved designs -- whether in energy programs or industrial processes.

Engineering and economic models, suitable for industrial age thinking, must give way to the developments of an information age which demands new economic constructs, new decisionmaking models and a new understanding of the constraints imposed by resource limitations. In today's highly volatile economy, energy can no longer be seen as an end in itself but as a means to enhance the well-being of a community. To successfully implement this notion, it is essential we define clearly what the goal of a political and economic society is and then design an energy policy that supports and nurtures that goal. Such a goal might be:

> To increase the efficient use of resources such that employment opportunities are accelerated, that gains in disposable income are created and that people and communities are given more control over their lives.

An Energetic Dogma

With this perspective goal in mind, too many conservation programs focus on BTU savings rather than on the employment impacts or the economic welfare of a community resulting from such programs. They fall prey to what Georgescu-Roegen might term an "energetic dogma" -- the measurement of such things as kilowatt-hours and payback rather than a determination of whether a given energy technology will help us reach a larger goal such as the one described above.

Alvin Toffler raises a similar point in a forward written for a book co-authored by Nobel physicist Ilya Prigogine entitled Order From Chaos. Toffler writes, "One of the most highly developed skills in contemporary Western Civilization is dissection: the split-up of problems into their smallest possible components. We are good at it. So good, we often forget to put the pieces back together again.

"This skill is perhaps most finely honed in science. There we not only break problems down into bite-sized chunks and mini-chunks, we then very often isolate each one its environment by means of a useful trick. We say 'ceteris paribus' -- all other things being equal. In this way we can ignore the complex interactions between our problem and the rest of the universe."

In our nation's energy programming, we seem to similarly catalogue energy programs according to how much energy is either saved or produced rather than to evaluate them in light of their contribution to increased income opportunities where it's most needed, or to how energy management can restore a measure of local control to a community.

Energy as a political and economic influence must be made visible through a more rigorous examination of what, at first glance, appear to be fundamental concepts but which, upon closer examination, dissolve into a misunderstanding of the structural relationships energy consumption creates within society. One such example is our tendency to rely upon prices as a sole or major determinant of whether or not an energy program is termed effective.

2.1 BEYOND PRICE COMPARISONS

To the extent, however, that prices are treated as the primary determinants of market allocation, we introduce a bias in the evaluation. This is because prices are rooted in the context of whether a sale is profitable or not -- that is, profitable to a business firm. In other words, businesses are the fundamental unit of reference with regard to price as a measure of value.

Yet, if we are interested in the economic well-being of a community rather than a single business firm -- seeking perhaps more employment opportunities for its residents -- but instead pursue energy strategies according to price measurements alone, we unwittingly introduce an economic bias against a goal such as higher employment levels.

This effect can be seen most clearly in conventional economic models which seek an equilibrium between supply and demand through the price mechanism. In these models employment impacts are treated as so many "externalities." This is especially ironic in light of the contradictory employment goals advocated by some who also advocate increased reliance on price-oriented strategies.

A specific indication that prices alone cannot help us determine the community impact of a given purchase is what often is called the "multiplier" effect. When a dollar is spent in any given community, it generates other economic activity. For example, when a family buys a new home, it is paying money to the contractor who built it and to the bank that financed the construction.

Moreover, to build the home, the contractor purchased materials from the local lumberyard and the electrical and plumbing supply shops in town. All of these businesses -- the contractor, the suppliers and the bank -- are employing people to support the needs of the family wanting a home.

The employees of these businesses, in turn, now have incomes which are spent. So the total level of spending has been "multiplied" from the purchase of the house. The cumulative impact of that or any other purchase can be measured; and, it turns out, each consumer purchase tends to generate a different multiplier. Any community interested in its own economic well-being, therefore, would want to be fully informed and mindful of the complete economic effects of its purchases or investments and their impacts on its constituents compared to the economic effects of an alternative expenditure.

As this study later will illustrate, when conventional energy purchases are made, their sale produces less of an economic ripple than when conservation measures are installed or when other consumer goods are bought. The calculations are complex but the analysis shows that a dollar spent for natural gas generates about $1.32 in overall economic activity for Nebraska. When the same dollar is spent for actual conservation retrofits, approximately $2.30 in activity is created.

As the energy savings from conservation measures are re-spent by a household on other consumer items, they generate $2.37 of two dollars of activity for each dollar's purchase. Such comparisons are a specific illustration that prices alone may bias decisions made by a community or the nation about the direction of its energy future.

2.2 THE MULTIPLIER CONCEPT

The purpose of this section is to develop a set of economic multipliers that can be used to assess the development impact of various energy expenditures on the economies of the DOE Region VII states--Iowa, Kansas, Missouri and Nebraska. Economic multipliers are indicators of the inter industry flow of goods and services in an economy. They are derived using a regional economic analysis method called Input-Output (I/O) analysis, one of the most widely used methods for estimating regional economic impact. Its theoretical foundations were moved forward by Nobel Prize economist Wassily Leontief and have been refined and explained by others during the 1960s and 1970s. (Leontief, 1966; Miernyk, 1967; Elliot-Jones, 1971). I/O models provide a framework to measure and interpret the level of economic activity of a region, be that a community, state, country, or the entire world as a single system.

I/O models are based on tables in a form indicating the economic buy-sell transactions among various sectors. The tables show from which sector different industries, governments, and consumers purchase goods and services (providing "input" to the sector) and where these agents sell goods and services (providing "output" to other sectors). As Emerson and Lamphear describe it:

"The main theme of [input-output analysis] . . . is <u>economic interdependence</u>. In a highly specialized economy such as that which characterizes the United States and its geographic components, several stages of production are involved in delivering a product or service to the ultimate consumer (final demand). Since numerous industries sell the majority of their output to other industries rather than to final markets, this intermediate production demand represents a sizeable portion of the total activity of an economy. Nationally . . . interindustry transactions represent more than 50 percent of the total dollar-value of transactions. Thus the activity of one industry may depend upon the activities of several other industries. These are the interrelationships that are captured in an input-output investigation."

Once an I/O table of economic inter-relationships has been built, one can use it to describe the impacts on the economy given specific levels of investment or demands. The indicators of these impacts are the "economic multipliers." The multiplier is the ratio of the total increase in economic activity to the initial investment or expenditure. Investment or expenditure made in a state or region generates economic activity beyond the initial expenditure.

The multiplier captures the extent of this activity. For example, assume a company makes an initial investment of $1,000,000 to build a factory. The construction firm hired to build the factory will buy supplies (such as concrete, lumber, and energy) from other companies; they will also pay laborers wages for work performed. The companies supplying materials will, in turn, purchase supplies; and workers will spend their wages on rent, food, and other items. Thus the initial investment of $1,000,000 is recycled, or "multiplied" throughout the economy. If the total increase in economic activity, after subtracting the value of goods and services imported to a region, is found to be $2,794,000, then the regional multiplier is said to equal 2.794.

A Transaction Table

An I/O model generates multipliers by computing the chain of transactions which must occur to produce output for a given level of investment or demand. Starting with the overall pattern of transactions in the region's economy, (called the "transaction table"), the purchases of an economic sector are allocated among the other economic sectors to develop the "direct requirements table". This table shows the average direct purchases from each sector per dollar of output of the producing sector. For example, in Table 2-1, a $100 demand or investment in agriculture, will be allocated 10% back to agriculture, 5% to manufacturing, and 85% to households. These sales are known as the direct effect component of the multiplier.

Table 2-1

Illustrative Direct Requirements Table

Input Output	Agriculture	Manufacturing
Agriculture	0.10	0.60
Manufacturing	0.05	0.20
Household	0.85	0.20
Total Direct Inputs	1.00	1.00

Continuing the example, sectors receiving direct payments during the first round will spend these payments making purchases from their suppliers. After this second stage of transactions comes a third, and a fourth, and so on. The generation of secondary activity through purchase of inputs in known as the indirect effect component of the multiplier. If an initial investment of $100 generates a direct effect of $100 and an indirect effect of $22, the total economic activity generated is $222; the multiplier is 2.22.

At each stage of transactions some of the economic activity will be translated into personal income for employees. The spending of this additional income will stimulate more economic activity. The activity resulting from increased consumer spending is known as the induced effect.

Summation of the direct and indirect effects is known as Type I multiplier. The total of direct, indirect, and induced effects is known as Type II multiplier. It is the latter which is more commonly used in economic analysis.

If a state economy is totally self-sustaining then the direct, indirect and induced effects offer a pure measure of increased economic activity. However, no state is an economic island. Many of the inputs or supplies purchased by sectors represent inter-state purchases. Expenditures for supplies bought from out-of-state firms will not turn over a "multiply" within the state under consideration. Rather, these expenditures will "leak" out of the state economic flow. Other "leakages" can be represented by funds going to savings.

Secondary Impacts

The multiplier effect alone does not provide a full picture of economic impacts resulting from increased investment or demand. Other potential effects are the displacement, respending, and substitution effects. The displacement effect occurs when investment in one sector displaces investment in another sector. For example, investment in a residential solar space and hot water heating system might displace or reduce the income of electric utility sales.

The respending effect occurs when an investment leads to increased consumer income. For example, an investment in a conservation technique might put more dollars back into the pockets of consumers. When the added income is spent on goods and services in the economy, additional economic activity is generated. This results in a positive respending effect. On the other hand, if the conservation technique is faulty, the consumer will lose purchasing power. This is known as the substitution effect.

The multiplier concept is not limited in application to measurement of investment and demand changes. Multipliers can also be developed for output, personal income, and value-added. Non-fiscal economic multipliers can also be generated. A common example is the employment multiplier which describes changes in employment given chanes in specific sector employment or demand. Harris and Ching (1983) have developed a resource multiplier which shows increases in water final demand given changes in the final demand for the output of a sector.

I/O Limitations

Input-Output analysis is a powerful descriptive and analytical tool. It is useful for selective stimulation, for understanding the chain reaction in motion among various sectors of the economy that a change in basic activities, such as decreased energy use, will have. It also provides a tool permitting disentanglement and measurement of direct and indirect effects.

However, I/O does have its limitations. It is based on several key assumptions which a policymaker should bear in mind. First, results of the model are only as dependable as the data. Survey methods and assumptions used to construct the data must be reliable. To this vein, Arrow and Hirsch (n.d.) note, "Very few manufacturers of any scale keep accurate accounts in a manner which permits them to summarize readily their annual shipments by geographical destination," and similar problems can exist with purchase data. Additionally, sector categories must adequately reflect the nature of the investment decisions under analysis.

The model assumes a "stable pattern of the flow of goods and services," (Leontief, 1966). This means that the transactions among sectors are not time dependent. The model reflects neither technological nor input substitution in the production process. Another problem related to time is that actual transactions during a single accounting year constitute the basis for the I/O structure. Any accounting irregularities particular to the sample year will thus be reflected in the coefficients (Bendavid-Val, 1983). Additionally, the model is based upon proportional relationships among sector flows. Thus, "if the quality of each input is doubled, the output is also doubled" (Emerson and

Lamphear, 1975). Another critical assumption in the model is that while transaction values among sectors represent average relationships, they are used to measure marginal effects (Lamphear and Roesler, 1973).

I/O analysis also ignores societal costs and benefits. For example, it does not account for environmental costs resulting from increased use of a resource or degradation of the environment. Another type of societal cost would be the toll that a temporary "boom town" might take on local services and infrastructure.

Despite these weaknesses, however, the use of multiplier analysis offers decisionmakers a descriptive tool that can assist in the evaluation of energy strategies and can undercover benefits or costs that price considerations alone often overlook.

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2.3 COMMUNITY SIZE AND THE RESULTING MULTIPLIER

For purposes of this study, we define a community as an economic unit in which people live, work and play. The specific geographic boundaries of a community may be defined in a number of ways: a neighborhood, village, town, city, county, state, nation, or the entire world.

The Concept of Income Leakage

To a greater or lesser degree, every person, family or community is linked to other persons or communities. Through our economic system we buy and sell and trade and borrow goods and services. The size of a community (a village versus a nation) directly affects expenditure leakages. For example, when a good is purchased in a local store, part of the purchase price goes to the local merchant in the form of income, part goes to the government (local, state or federal) in the form of taxes, and part goes to the supplier of the goods. Eventually, part of the original purchase price of that good ends up in the pocekts of maybe a manufacturer and/or resource provider. In short, some of the price of that purchase leaves the local economy and flows to the other parties in the production/supply system. This transfer of income to parties outside o the community constitutes a leakage.

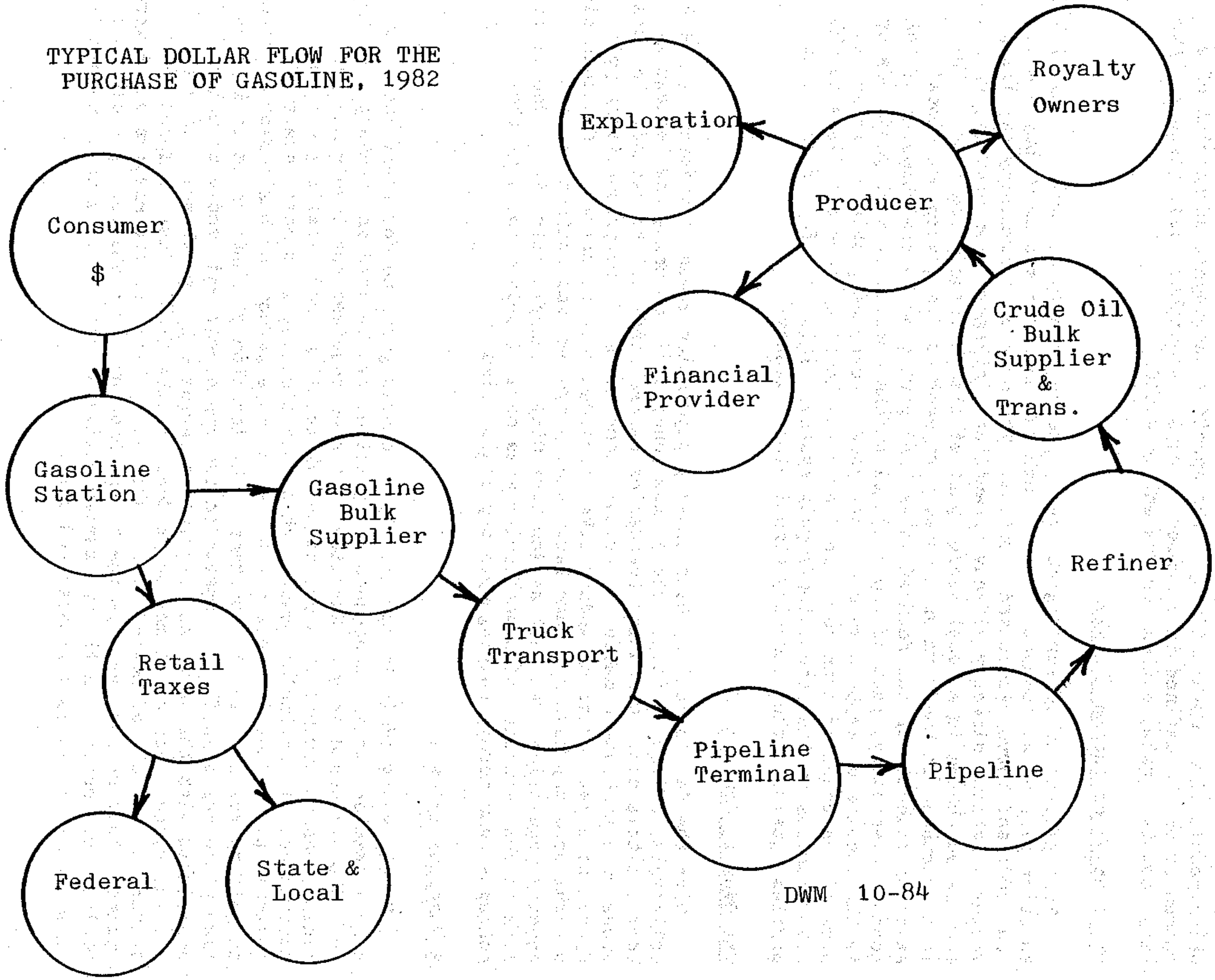
The Density Concept

With the development of high density population areas (New York, Southern California, Denver, Chicago, etc.), the concept of community and leakage is bent a little bit. Community boundaries become difficult to define. In rural areas such as Western Nebraska, certain components of the production/supply system of a particular commodity like petroleum must be present. Consequently, a rural area may have the same basic supply system components as a high density population area such as New York City. Consequently, it is useful to look at the structure of a particular area more closely when using these concepts than merely relying upon population size.

A Gasoline Example

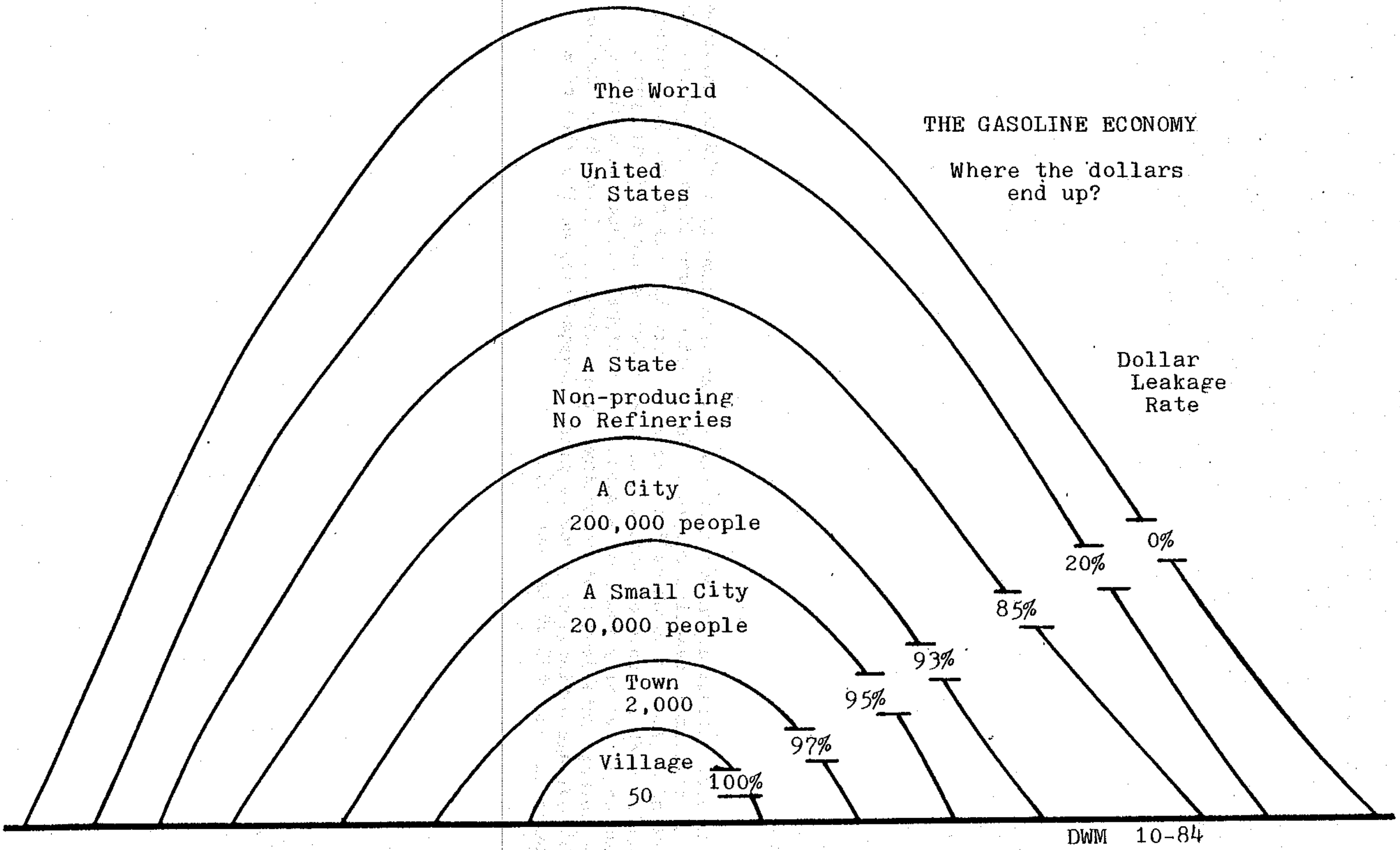
Nearly every adult in our society purchases gasoline for their car on a fairly regular basis. Consequently, gasoline can be used as an example of the concepts discussed above. Gasoline as a good requires the involvement of mining, manufacturing, transportation, wholesaling, and retailing economic activities. If we include taxes, this good also involves most levels of government. In total, there may be ten or more persons or businesses involved in getting gasoline to the consumer. The location of where these activities take place has significant impacts on the employment and income creation associated with the purchase of gasoline versus other purchases. In our current system, crude oil may be produced in the Middle East, shipped by tanker to the Gulf of Mexico Coast, shipped by barge up the Mississippi River, refined, then shipped by pipeline to the Midwest, then shipped by truck to a wholesaler, and in turn the wholesaler delivers gasoline to a gasoline station in a town where it is purchased and used.

TYPICAL DOLLAR FLOW FOR THE PURCHASE OF GASOLINE, 1982



DWM 10-84

The above illustration outlines the transaction flow of a simple gasoline purchase at a local gasoline station. An important consideration concerns what percent of a gasoline purchase flows to each party in this rather long supply/production system. More of each dollar that flows to parts of the system outside of a community (whether a state or a village) relates to a higher income leakage rate from that community. The following illustration provides a rough average estimate of purchase price leakage based on the size of a community in this part of the country.


THE GASOLINE ECONOMY
Where the dollars end up?
Dollar Leakage Rate
The World
United States
A State
Non-producing
No Refineries
A City
200,000 people
A Small City
20,000 people
Town
2,000
Village
50
0%
20%
85%
93%
95%
97%
100%
DWM 10-84

Community Scale

In a small village near Lincoln, Council Bluffs or Kansas City where even a gasoline station does not exist, probably 100 percent of gasoline purchases made by the members of that community constitutes a leakage of income. On the other hand, if we consider the entire world, there are no leakages, since the world includes all the transactions and economic activities associated with providing gasoline to consumers.

However, public policy is made at the local, state, or national level. Income leakages are similar to balances of trade. Understanding how the purchase of particular goods and services will affect the local, state, or national community is very important. The reason that a village may have a 100 percent leakage rate and a non-oil producing/refining state has an 85 percent leakage rate is due to whether particular parts of the supply/production system are found within these respective communities. The table on the following page provides a very general listing of the likely parts of the gasoline supply/production system that may be found in differently sized communities.

Generally, the larger the community, the larger and more complete the economy that is inherent to it. Simply put, more and more of the system are found in the larger and larger communities. With more of the system within the community, more of the income spent on gasoline remains (at least initially) within the community.

For example, in 1982 according to National Petroleum News, the petroleum supply system supported about 1.7 million jobs. This industry, as other sections of this report have shown, is not employment intensive. Approximately 34 percent of all system jobs are in retailing with another 14 percent in wholesaling activities like bulk stations, truck transports, and pipeline terminals. Petroleum pipeline provides another one percent of the total employment. Crude oil refining and processing supports about 11 percent of the jobs. The extraction of crude oil supports the most jobs with 40 percent of the total. Of course, a job in oil refining is not worth the same as a job in the local gasoline station. The bulk of the better paying jobs associated with this industry is found in those few states where the oil is produced and refined. In conclusion, income leakage rates are important information essential to the development of economic impact multipliers.

Table 2-2

Typical Presence of Gasoline Supply Activities by Community Size, 1982

X - indicates that the activity is probably present.

Gasoline Stations	X	X	X	X	X	X
Bulk Suppliers		X	X	X	X	X
Truck Transports		X	X	X	X	X
Pipeline Terminals			X	X	X	X
Pipelines				X	X	X
Refineries					X	X
Bulk Purchasers					X	X
Producers					X	X
Explorers					X	X
Financiers					X	X

Village - 50 people

Town - 2,000 people

Small City - 20,000 people

City - 200,000

State - non-producing, no refineries

2.4 REGION VII ENERGY AND HOUSEHOLD MULTIPLIERS

In this section of the report we explain the methodology used to construct and estimate what are known as Type I energy and household multipliers for the Region VII states. By comparing the resulting multipliers, policymakers can determine what types of expenditures have the greatest economic impact within a geographical region, and what the impact would be (in relative terms) if expenditures were shifted from one type to another -- for example, from natural gas to other household purchases. The principal reason for calculating these multipliers is to compare the economic effects of shifting expenditures from energy payments to general consumer spending through efficiency improvements.

Although the analysis is limited in a number of respects, it provides a helpful first-round look at the structural relationships of and the impacts resulting from conventional energy purchases compared to other consumer expenditures. Limited by available data, this analysis includes only Type I output multipliers which refers to the impact of the direct and indirect goods and services needed to create one dollar's worth of final demand. To generate a more complete estimation of impacts, the so-called induced effect -- i.e., the economic activity generated by the increase in household incomes -- should be included through construction of Type II output multipliers. But constraints in data and research time prevent the generation of the Type II multipliers at this time

The Burford-Katz Approach

In order to derive the multipliers presented here, a standard three-step procedure was followed. First, aggregate industry data for electricity, natural gas and petroleum sectors were developed to identify industry expenditures by type such as salaries, fuel purchases, interest payments, etc. Second, the allocated expenditures were divided into state and non-state expenditures to determine the rate of leakages from a local economy. Where there was ambiguity in the expenditures, the expenditures in question were conservatively assumed to have occurred within the state. Third, the remaining in-state expenditures, using what we call the Burford-Katz methodology, were multiplied by a constant to generate the total direct and indirect output multipliers.

Despite the value of output multipliers in assisting local decisionmakers in policy formation, an accurate survey-based input-output model is both costly and time consuming to construct. Moreover, data that is readily available may not always be appropriate for use in such analysis. There is sufficient evidence, however, to suggest that a reasonably accurate estimation of output multipliers can be developed since the major determinant of an industry's output multiplier in any given region is the fraction of purchases made within the region. Simply stated, the more an in-state manufacturing company purchases its supplies locally, the greater the output multiplier for that region.

Burford and Katz found that the formula

$$u_j = 1 + \left(\frac{1}{1 - \bar{w}}\right) w_j$$

closely approximates the Type I output multiplier, u, of industry j where w_j represents the ratio of in-state interindustry expenditures of the jth industry, and w is the average instate purchase of all industries within the state. (See Burford and Katz, 1981).

Using the average U.S. interindustry expenditure ratio of .5267 as determined by Bureau of Economic Analysis, data was set equal to w. Although this may tend to somewhat inflate respective output multipliers found on the following pages, by treating all expenditures within a state on equal terms, a clear relationship can be established among competing expenditures. Indeed, Burford and Katz found a surprisingly high correlation between multipliers generated with their methodology and those produced by the more detailed survey-based I-O models.

Co-efficient Development

Table I on the next page outlines the allocation of expenditures by the electric utility sector in each of the four states as a percentage of operating revenues (column one) followed by estimates for the leakage rates for each expenditure, also expressed as a percent. When these two figures are multiplied together, the result is the net in-state interindustry expenditures for the electric utility sector for the four-state region. As might be expected, the biggest differences occur in the purchased fuel requirements and in the debt service required to capitalize the utility operations.

Because Kansas has a significant production of natural gas within the state, it is able to purchase more of its boiler fuel within state boundaries. However, much of its fuel comes in the form of coal which is almost completely imported. Thus, the Kansas utilities export approximately 44% of its purchased fuel dollars. Iowa, on the other hand, exports almost all (94%) of its purchased fuel dollars since it has very little indigenous fossil fuel resources.

The second largest expenditure for the electric utilities (first for Nebraska) is the annual debt service, whether interest on bonds or dividends to stockholders. Because so much of the financing is provided by out-of-state investors, 98% or more of the annual payments flow out of the states' economies. Making conservative assumptions about the flow of remaining dollars for each of the other expenditures, we find the following intrastate purchases made by the electric utility sector:

Iowa - 48.13%
Kansas - 61.16%
Missouri - 45.51%
Nebraska - 28.10%

Using a similar analysis for the natural gas and petroleum sectors in each state, estimates of the intrastate expenditure co-efficients were generated for these sectors as well. Combining these results with the Burford-Katz methodology produces the Type I output multipliers found on Table (2). Finally, a regional household sector was added to strengthen the comparison of the resulting energy multipliers. This was done by estimating leakages (i.e., out-of-state purchases) for typical household expenditures to be held to 35%. This yields an intrastate ratio of 65% to be used in the Burford-Katz formula.

Table 2-3

Estimated Intrastate Expenditures by the Electric Utility Sector By State
As a Percent of Revenues

CATEGORY	IOWA		
	Percent of total	Leakage Rate - %	In-state Net - %
fuel	26.83	94.1	1.58
purchased power	3.69	100	0.00
salaries	9.64	0	9.64
benefits	1.87	33	1.25
O & M	10.46	5	9.94
dep/amort	10.27	5	9.76
taxes	10.49	33	7.03
other taxes	4.92	0	4.92
debt service	17.72	98.5	.27
retained earnings	3.94	5	3.74
TOTALS	100.00	-	48.13

CATEGORY	KANSAS		
	Percent of total	Leakage Rate - %	In-state Net - %
fuel	38.26	44.4	21.27
purchased power	4	100	0
salaries	8.38	0	8.38
benefits	1.62	33	1.09
O & M	9.02	5	8.57
dep/amort	8.43	5	8.01
taxes	4.9	33	3.28
other taxes	6.8	0	6.80
debt service	14.82	98.8	.18
retained earnings	3.77	5	3.58
TOTALS	100.00	-	61.16

CATEGORY	MISSOURI		
	Percent of total	Leakage Rate - %	In-state Net - %
fuel	29.01	77.5	6.53
purchased power	6.32	100	0.00
salaries	12.23	0	12.23
benefits	2.37	33	1.59
O & M	7.83	5	7.44
dep/amort	7.74	5	7.35
taxes	10.74	33	7.20
other taxes	.7	0	.70
debt service	14.47	97.9	.30
retained earnings	2.29	5	2.18
TOTALS	100.00	0	45.51

CATEGORY	NEBRASKA		
	Percent of total	Leakage Rate - %	In-state Net - %
fuel	21.12	99.9	.02
purchased power	12.36	100	0.00
salaries	12.35	5	11.73
benefits	0	0	0.00
O & M	7.5	5	7.13
dep/amort	7.32	5	6.95
taxes	1.97	0	1.97
other taxes	0	0	0.00
debt service	37.38	99.2	.30
retained earnings	0	0	0.00
TOTALS	100.00	–	28.10

Region VII Results

Since Iowa retains so little of the petroleum dollar, the economic activity generated by purchased oil products is minimal at best. On the other hand, since Kansas produces almost all of the oil it consumes, it has an extremely high output multiplier. This may be significantly overstated, however, since much of the venture capital used to underwrite production and refining operations does not remain in the state. Data available on the petroleum industry does not allow a more complete determination of the outflow of earnings onventure capital although it appears significant. With the exception of the Kansas petroleum multiplier, it appears that the household sector purchases generate more economic activity than conventional energy purchases.

Table 2-4

Estimated Type I (Direct-Indirect) Output Multipliers for Region VII STates

	IOWA		KANSAS	
	% Instate Purchase	Output Multiplier	% Instate Purchase	Output Multiplier
Electricity	48.13	2.02	61.16	2.29
Natural Gas	13.8	1.29	30.2	1.64
Petroleum	10.9	1.23	97.8	3.06
Household	65	2.37	65	2.37

	MISSOURI		NEBRASKA	
	% Instate Purchase	Output Multiplier	% Instate Purchase	Output Multiplier
Electricity	45.51	1.96	28.1	1.59
Natural Gas	13.8	1.29	15.2	1.32
Petroleum	13.1	1.28	14.2	1.30
Household	65	2.37	65	2.37

2.5 ENERGY AND EMPLOYMENT PATTERNS

Every economic activity through its normal operations supports jobs ranging from secretaries to corporation presidents to line workers. The number of jobs and the amount of salaries created by a particular economic activity depends in part on its labor to capital ratio. Capital intensive industries tend to provide somewhat higher paying jobs than do the labor intensive industries. Consequently, it is important in any analysis to adjust the number of jobs supported by equalizing the average salary paid per job. Capital intensive industries tend to support fewer jobs per million dollars of sales than do labor intensive industries. The data strongly suggests that energy production/supply systems tend to support fewer jobs per million dollars of sales than most any other type of economic activity. This is due primarily to the capital intensive nature of these industries. (Howe and Rasmussen, 1982; and Vogely, 1976)

Nationally, on the average, the petroleum industry supports 10.7 jobs per million dollars of sales, the natural gas industry supports 10.9 jobs, and the electric industry supports about 5.5 jobs per million dollars of sales. On the other hand, nationally the service industry supports over 22 jobs per million dollars of sales (jobs have been adjusted so that the salary received per job is equal for all sectors), the construction industry supports over 23 jobs, and the manufacturing sector supports nearly 18 jobs.

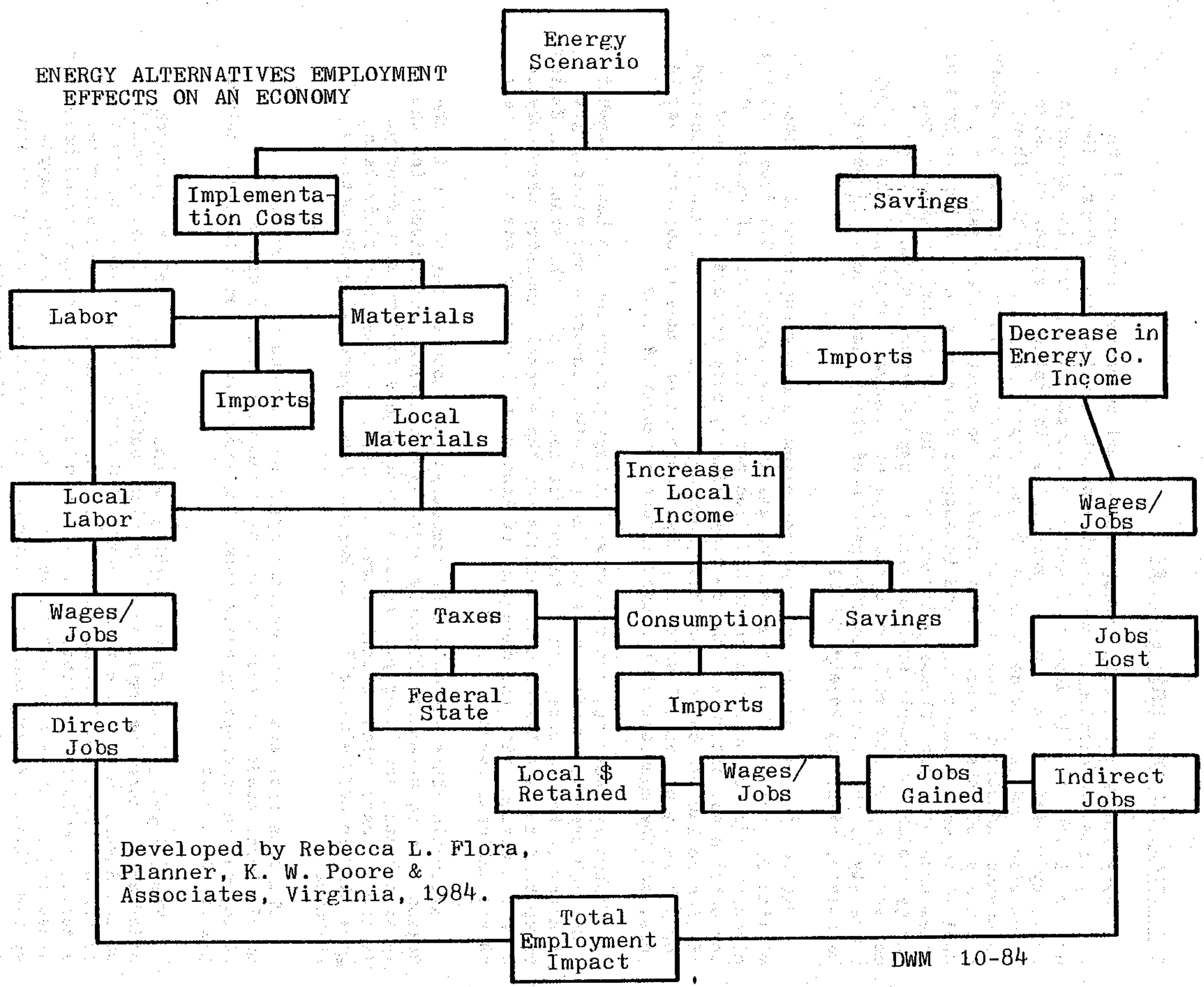
Generally speaking, the states within Region Seven tend to have somewhat lower job creation coefficients for the petroleum industry and natural gas industry (with the exception of Kansas for natural gas). The states in Region Seven tend to have higher coefficients for the electric industry when compared with the nation, with the exception of Kansas which has the same coefficient as the national average.

Reflecting this Region's less industrialized nature, the states in the Region tend to have significantly higher job creation coefficients for the service sector and lower job creation coefficients for the manufacturing sector. Construction, retail trade, and wholesale trade coefficients are generally several similar for the Region when compared with the national averages.

The data indicates that dollars spent on services, construction, manufactured goods, or governmental services will tend to create more employment on an on-going basis than like expenditures for petroleum, natural gas or electricity.

The following illustration highlights the conclusions of the research undertaken concerning employment creation coefficients, nationally, within Region Seven, and for the four states. Following the illustration are a series of tables that summarize the data that was used in this analysis. Finally, the last illustration in this section provides a simplified model for assessing the net employment impact of substituting local energy supply systems (i.e. conservation or efficiency) for conventional energy systems (i.e. petroleum, natural gas, or electricity). (Flora, 1984)

ENERGY ALTERNATIVES EMPLOYMENT EFFECTS ON AN ECONOMY



Developed by Rebecca L. Flora, Planner, K. W. Poore & Associates, Virginia, 1984.

DWM 10-84

Table 2-5

Region VII Employment Coefficients - Salaries

Salaries (10^6 $)

		Iowa	Kansas	Missouri	Nebraska
1977	Construction	682	628	1,175	438
	Manufacturing	3,402	2,164	5,807	1,075
	Mining	38	183	145	30
	Retail Trade	1,148	924	2,094	581
	Wholesale Trade	861	359	1,615	494
	Services	1,202	1,002	2,790	280
	Government	1,800	2,076	3,540	1,488
	Total	9,133	7,336	17,166	4,386
1982	Coal	3	11	41	-
	Natural Gas	23	59	151	40
	Petroleum	208	479	345	169
	Electricity	115	69	246	116
	Total	349	618	783	325

Note: The data for the four tables in this section were drawn largely from U.S. Government sources including the Department of Commerce, Bureau of the Census reports on mining, retail trade, wholesale trade, manufacturing, transportation, services and government. Also used was the U.S. Department of Energy's Federal Energy Data System.

Table 2-6

Region VII Employment Coefficients - Annual Sales

Sales (10^9 $)

		Iowa	Kansas	Missouri	Nebraska
1977	Construction	2.7	2.3	4.5	1.9
	Manufacturing	23.5	16.0	33.2	8.7
	Mining	0.2	3.2	1.0	0.2
	Retail Trade	9.8	7.7	15.9	5.1
	Wholesale Trades	20.1	17.5	35.1	10.6
	Services	1.6	1.3	3.7	1.0
	Government	3.6	4.2	7.0	2.6
	Total	61.5	52.2	100.4	30.1
1982	Coal	0.4	0.3	0.8	0.1
	Natural Gas	1.0	1.2	1.4	0.5
	Petroleum	3.1	2.8	4.9	1.8
	Electricity	1.2	0.8	2.0	1.1
	Total	5.6	5.0	8.4	3.4

Table 2-7

Employment Coefficients - Employees

		Employees			
		Iowa	Kansas	Missouri	Nebraska
1977	Construction	55,979	52,582	89,395	36,000
	Manufacturing	245,046	172,414	436,695	88,000
	Mining	2,630	12,778	9,148	2,000
	Retail Trade	189,23	150,882	304,197	103,000
	Wholesale Trade	70,291	27,465	120,410	42,300
	Services	168,511	132,222	329,143	40,101
	Government	178,373	162,000	261,000	114,000
	Total	910,053	710,343	1,549,988	425,401
	Coal	195	400	1,297	--
	Natural Gas	1,332	2,647	4,669	1,715
	Petroleum	18,030	25,211	29,081	12,254
	Electricity	5,804	4,833	11,707	4,940
	Total	25,361	33,091	46,754	18,909

Table 2-8

Adjusted Employment Coefficients, 1977 & 1982

		Region jobs per million dollars and expenditure					
		U.S.	VII	Iowa	Kansas	Missouri	Nebraska
1977	Construction	23.5	23.5	22.8	24.5	23.9	20.7
	Manufacturing	17.8	14.0	13.3	12.4	16.1	11.3
	Mining	–	7.9	14.3	5.1	13.3	17.3
	Retail Trade	11.3	11.3	10.7	11.0	12.1	10.5
	Wholesale Trade	4.3	3.7	3.9	1.9	4.2	4.3
	Services	22.7	63.7	70.6	72.8	68.3	26.3
	Government	–	33.5	32.8	32.3	33.3	29.5
	Total	12.7	14.3	13.6	12.9	15.7	13.4
1982							
	Coal	22.6	2.2	0.4	2.4	3.6	0.0
	Petroleum	10.7	4.4	1.5	3.2	7.2	4.9
	Natural Gas	10.9	6.2	4.4	11.3	4.6	6.2
	Electric	5.5	7.0	6.3	5.5	8.0	7.0
	Total	7.3	6.1	4.1	8.0	6.1	6.2

Note: The coefficients have been adjusted to reflect an annual salary of $20,000 for each of the years and employment sectors.

Refernces

Howe, Keith M. and Rasmussen, Eugene F. Public Utility Economics and Finance, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1982.

Vogely, William A., Editor. Economics of the Mineral Industries, New York, New York: American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., 1976.

Flora, Rebecca L. "Economic Evaluations in Energy Planning," National Community Energy Management As An Economic Development Strategy Colloquium, Lincoln, Nebraska: Nebraska Energy Office and University of Nebraska, October, 1984.

3.0 USING MULTIPLIER ANALYSIS IN STATE-SPECIFIC CASE STUDIES

In section two of this report, the concept and the development of the various energy multipliers were explained. To illustrate how the multipliers can be used to estimate the overall well-being of a community as a result of different energy expenditure streams or investments, this section of the study uses six different illustrations in the Region VII states to compare the substitution of energy efficiency measures for conventional energy usage. The comparisons are made using the multipliers provided in Table 2-4 and in the technical supplement to this report on energy conservation multipliers.

With any energy efficiency strategy there are four basic economic multiplier effects. First, an investment must be made to finance and implement the energy efficiency measures. Second, when efficiency measures are implemented, energy use declines. Declining energy use has an effect on the energy supply system that provided that formerly required energy. Third, from the dollars savings associated with the reduction in energy use, the consumer will have additional disposable income for other spending.

Since financing energy efficiency measures is not normally free, part of the annual savings will be required for a number of years to pay for the conservation measures. However, if a program is properly constructed, the consumer will have additional funds left over each month or year for other general spending. Finally, over the life of the efficiency measure, the consumer will realize continued energy dollars savings. This cumulative change in available disposable income may result in altered long-run spending habits. As a general rule, dollars saved from reduced conventional energy use result in greater and more localized spending.

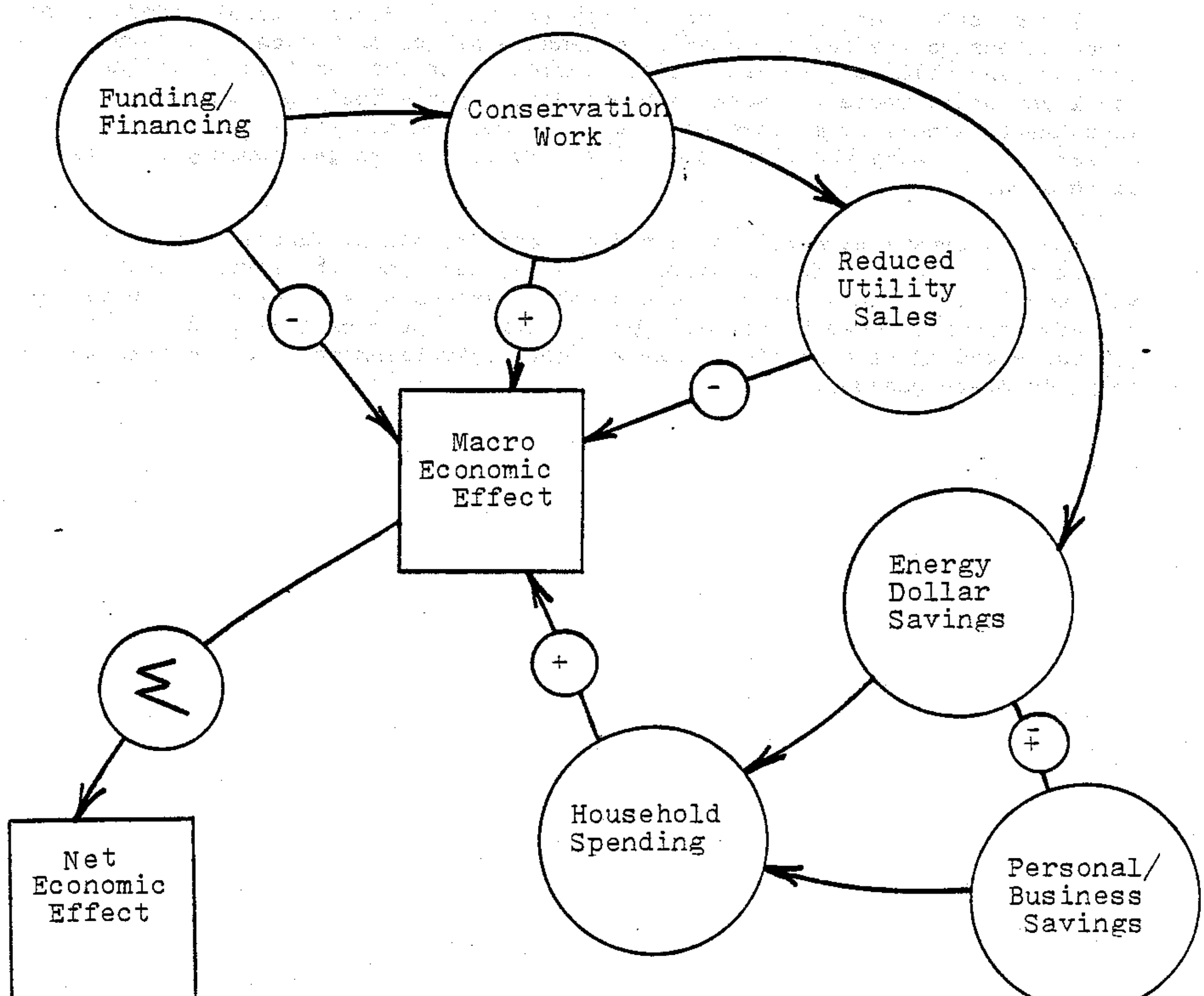
3.1 A NATURAL GAS HOME EFFICIENCY EXAMPLE IN KANSAS

As already noted, energy conservation results in a number of economic effects that may alter the community wide economy. First, consumers must finance their improvements. Such financing costs are generally viewed as having a negative effect on the overall economy. For purposes of this analysis, these effects will not be quantified. Successful financing leads to workers and materials being hired and purchased.

Energy efficiency work, particularly at the residential level, tends to be labor intensive (versus the capital intensive nature of natural gas supply systems) and will as a general rule, provide additional employment in the local community where the work is being done. The effects of these investments generally enlarge the local economy and are viewed as positive effects. Following the completion of the work, natural gas consumption will be reduced.

Reduced consumption will mean reduced utility sales, income, etc. The effect is viewed as being negative. Finally, each year the lower energy use will result in dollars saved. Part of this savings will be placed in personal savings accounts, used to pay off the investment, or more likely, used for general spending (i.e. clothes, meals, food, entertainment, etc.) within the local or state economy.

The Spending Stream



The 1982 Situation

In 1982, Kansas consumed according to the U.S. Department of Energy about 412 trillion BTU of natural gas at a retail cost of $1.2 billion. The average retail price is estimated at $2.96 per million BTU. From this study's research, the Type I household multiplier was found to be 2.37 for Region VII. This multiplier would be used to determine the effect of general spending increased due to energy consumption reductions. The Kansas Type I natural gas utility multiplier was found to be 1.64. This multiplier would be used to determine the effect of reduced gas sales. Finally, the energy efficiency Type I multiplier was found to be 2.26. This multiplier will be used to determine the investment effect of the conservation work.

A One Percent Conservation Scenario

If Kansas instituted a program to reduce in one year one percent of their 1982 natural gas consumption through residential conservation measures, about 4.12 trillion BTU of gas would be saved. In order to accomplish this savings it is conservatively estimated that $60.9 million of investments would be required. The first year dollars savings is estimated at $12.18 million carrying a five year payback on initial capital.

Sixty million dollars invested in conservation measures would create about $137.6 million in direct and indirect beneficial effects for the Kansas economy. The benefits of this investment would be a one time economic enhancement [$60.9 million x 2.26 (economic multiplier) = $137.6 million]. Of course, as already noted, from this beneficial effect the cost of capital would have to be deducted.

In terms of the respending effect, the $12.18 million reduction in gas purchases would result in $28.87 million worth of new general household spending [$12.19 million x 2.37 (multiplier) = $28.87 million]. Conversely, the $12.18 million reduction in gas sales would result in negative utility effects of $19.98 million [$12.18 million x 1.64 (multiplier) = $19.98 million]. Overall, the net effect is positive and equal to $8.89 million [$28.87 million - $19.98 million = $8.89 million].

Over a ten year period (excluding any inflationary effects), the net benefit from respending alone would generate $88.9 million in additional Kansas economic activity.

3.2. CENTER PIVOT PROGRAMS - A SECOND KANSAS EXAMPLE

For purposes of this example, we are assuming a series of center pivot irrigation systems with the following characteristics. The average well depth is 300 feet. The average corn yield per bushel is 135 bushels per acre. The system is power by diesel fuel and the average corn price is $3.00 per bushel. The estimated gross income per acre would be about $405.00. Diesel fuel costs are estimated at $73.00 per acre.

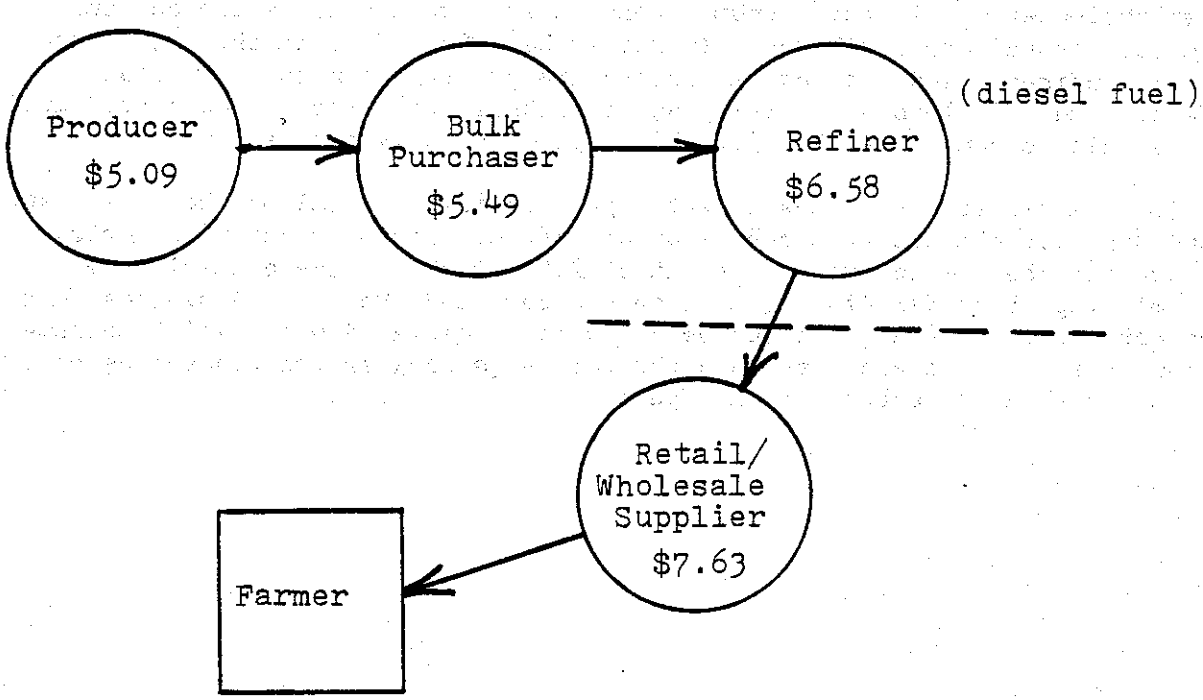
Two conservation measures would be implemented to reduce water and energy use. First, on the average, a comprehensive water scheduling program will generally reduce fuel use by 35 percent. The second measure, pumping plant maintenance and rehabilitation, will generally produce about 30 percent savings in fuel use. When the two measures are jointly implemented, savings averaging about 45 percent can be realized. Consequently, a conservation program of this natural would provide annual fuel savings of about $32.85 per acre in year one.

A 50,000 Acre Conservation Program

We are assuming a program that would include 50,000 irrigated acres to be covered with water scheduling and pump maintenance. The estimated first year fuel savings would equal about $1.643 million dollars. These savings would result in a respending effect of $3.894 million [$1.643 million x 2.37 (household multiplier) = $3.894 million]. Reduced petroleum sales in Kansas would affect only the petroleum wholesale and retail trade segment of the petroleum supply system since the refiner likely would find other outlets for its product. Reduced sales would result in an estimated $2.136 million in reduced economic activity[$1.643 million x 1.3 (petroleum trade multiplier) = $2.136 million]. The net effect would be about $1.758 million in expanded economic activity. Over the ten year period the economy would experience nearly $18 million in expanded economic activity from the net respending effect alone (household spending effect less the petroleum trade effect, and excluding any investment effects).

In most scenarios the positive economic benefits of reduced energy use will outweigh significantly the negative effects of reduced petroleum trade or utility sales. In addition to these net positive benefits, there are benefits associated with the initial investments in conservation measures. These two positive benefits provide the benchmark for evaluating how much can be invested to set these events into motion.

Petroleum Supply Flow



3.3 A REHAB PROJECT IN MISSOURI

Multiplier analysis can be applied to assess some of the economic impacts of a superinsulation rehabilitation project in St. Louis. The "Rehab 2000 Project" has the goal of superinsulating approximately 2,780 residential units over the next ten years.

The investment required is approximately $3,500 per unit, adjusted for inflation in the future (see table on next page). The direct and indirect effect are the investment dollars spent on construction multiplied by the conservation multiplier for Missouri developed earlier in this study.

The respending effects show the economic impact of dollars made available to households from the savings accruing from the superinsulation effort. The substitution effect is the economic benefit lost when dollars are no longer used for natural gas purchases. It should be noted that, in this case, the direct, indirect, and respending effects are greater than the substitution effect. Thus the loss of activity due to substitution for gas does not impair the overall economic viability of this type of conservation effort.

The overall economic impact of the project is the total of the direct and respending effects less the substitution effect. Over the ten year period of the project the cumulative investment of $12,692,975 yields a cumulative economic impact of $43,073,301. It should be noted that the cumulative impact does not represent the total economic impact. Insulated units will continue to generate positive benefits into the future as long as the respending effect is greater than the substitution effect.

Table 3-1

MISSOURI

Case Example

St. Louis Economic Impact--Rehab 2000 Project

Year	No. of Units	Added Cost per Unit	Annual Savings per Unit	Direct and Indirect Effect (Investment Cost x 2.2816	Respending Effect (Total Savings x 2.37)	Substitution Effect (Total Savings x 1.29	Annual Economic Impact	Cumulative Economic Impact
1983	1	$3,500	$ 950	$ 7,986	$ 2,252	$ 1,226	$ 9,012	$ 9,012
1984	30	3,500	950	239,568	69,797	37,991	271,374	280,386
1985	75	3,675	997	628,866	250,466	136,330	743,002	1,023,388
1986	200	3,859	1,047	1,760,939	759,305	413,293	2,106,951	3,130,339
1987	275	4,052	1,100	2,542,387	1,514,667	824,439	3,232,615	6,362,954
1988	350	4,254	1,155	3,397,074	2,548,473	1,387,143	4,558,404	10,921,358
1989	425	4,467	1,212	4,331,561	3,895,029	2,120,079	6,106,511	17,027,869
1990	450	4,690	1,273	4,815,317	5,448,720	2,965,759	7,298,278	24,326,147
1991	475	4,925	1,337	5,337,518	7,227,782	3,934,109	8,631,191	32,957,338
1992	500	5,171	1,404	5,889,077	9,253,722	5,036,836	10,115,963	43,073,301

Source: Columns 1 - 4 from Roger A. Tinklenberg, "Economic Implications of Climate Appropriate Residential Design (Superinsulation)," Proceedings, Community Energy Management As An Economic Development Strategy, Lincoln, Nebraska, October 14-16, 1984; columns 5-9 developed by applying multiplier analysis generated in this study.

Clearly, the "Rehab 200" superinsulation effort, under this analysis, yields positive and substantial economic benefits to the community.

3.4 BENEFITS FROM IOWA'S I-SAVE PROGRAM

The conservation and conventional fuel multipliers developed earlier in this report can be used to illustrate the impact on the Iowa economy of various energy use scenarios.

Residential data on an Iowa conservation program (I-SAVE) was made available by the Iowa Energy Office. The program consists of residential audits. Audit measures are then recommended to customers for implementation. Estimates were made of the expected number of consumers who would implement the recommended audit measures (e.g. insulation, caulking, etc.). Using the multiplier methodology for residential conservation developed in Section 4-6 of this report, a Type I multiplier of 2.3454 was developed for the Iowa program. The multiplier indicates the expected economic activity generated for every dollar invested in the conservation measures indicated in Table 3-2

Table 3-2 shows the multiplier effects of various scenarios under the I-SAVE program. The Type I multiplier of 2.3454 would yield an economic impact of $175,159,163 from an original consumer investment in conservation measures of $74,682,000. This assumes that 100% of the expected audit measures are implemented by customers.

Of particular significance are scenarios II and III. Scenario II shows the importance of using in-state labor sources. When labor is contracted outstate, the multiplier drops to 1.4308, yielding a net loss in potential economic activity of 39% or $68.3 million.

Table 3-2

IOWA-BASED PROJECTIONS FROM THE RESIDENTIAL CONSERVATION PROGRAM (I-SAVE) THROUGH 1985

Audit Recommended Measure	% Audited That Will Adopt	(MBTU/yr)** Energy Savings Total	Annual Savings Total ($)*	Average Cost ($)	# of Customers***	Total Customer Expenditures ($)
Insulation	28	877,298	6,895,562	2,420	13,794	33,381,480
Storm Windows/Doors	32	228,592	1,796,733	896	15,765	14,030,850
Caulking/Weatherstripping	89	149,080	1,171,769	90	43,847	3,946,230
Automatic Thermostat	26	117,842	926,238	100	12,809	1,280,900
New Heating System	25	342,412	2,691,358	1,670	12,317	20,569,390
Furnace Modification	13	57,645	453,089	230	6,405	1,473,150
TOTAL		1,772,869	13,934,749			74,682,000

Based on research conducted by Northern States Power Company and Argonne National Laboratories, Contract W-7405-eng. 26 and data supplied by the Iowa State Commerce Commission.

* Based on a $7.86 price of usable MBTU natural gas (furnace efficiency = .7)

** Note that in the Northern States Power evaluation the actual energy savings was two-thirds of the predicted.

*** Does not total 49,266 since customers adopted more than one measure

TABLE 3-3

IOWA

Case Example

Type I Multiplier Effects for Various Residential Conservation Scenarios

Scenario	Assumptions	Investment	Multiplier	Economic Impact
I.	100% of goal, status quo.	$74,682,000	2.3454	$175,159,163
II.	100% of goal, outside contracting--labor.	$74,682,000	1.4308	$106,855,006
III.	100% of goal, instate insulation industry	$74,682,000	2.8561	$213,299,260
IV.	75% of goal, status quo.	$56,011,500	2.3454	$131,469,372
V.	50% of goal, status quo.	$37,341,000	2.3454	$ 87,579,581
VI.	25% of goal, status quo.	$18,670,500	2.3454	$ 43,789.791

The potential benefits accruing to the state when instate material suppliers are present is depicted in Scenario III. Would the state attract an insulation industry sufficient to support I-SAVE conservation efforts, the multiplier would increase to 2.8561, generating a net increase in economic activity of 22% or $38 million in this example.

Type I multipliers represent only one impact of conservation expenditures. Other impacts are realized through the economic activity generated when a consumer gains spending power through savings on lower energy bills reflecting the results of conservation efforts. This is the "household" multiplier of 2.37 shown in Table 3-4.

Another impact known as the "displacement effect" occurs when energy purchases for heating fuels, such as natural gas, decrease due to successful conservation measures. The economic benefits generated through spending on natural gas are "displaced" when energy conservation occurs. In Table 3, the natural gas multiplier of 1.29 is considerably lower than the conservation multipliers. Thus, in this case, when conservation "resources" are substituted for conventional resources, a positive economic impact accrues to Iowa.

TABLE 3-4

IOWA

Case Example

Comparison of Economic Impacts
Respending Effect

Scenario	Assumptions	Savings	Conservation	House-hold	Natural Gas
I.	100% of goal, status quo.	$73,934,749	2.35	2.37	1.29
II.	100% of goal, outside con-tracting--labor.	$13,934,749	1.53	2.37	1.29
III.	100% of goal, instate insulation industry	$13,934,749	2.86	2.37	1.29
IV.	75% of goal, status quo.	$10,451,062	2.35	2.37	1.29
V.	50% of goal, status quo.	$ 6,967,375	2.35	2.37	1.29
VI.	25% of goal, status quo.	$ 3,483,687	2.235	2.37	1.29

Note: Payback period of conservation measures estimated at 5.2 years.

3.5 BONDING FOR IOWA'S PUBLIC BUILDING CONSERVATION RETROFIT PROGRAM

An especially innovative proposal advanced by the Iowa Energy Policy Council (EPC) is to secure an $80 million bonding authority to finance energy efficiency improvements in state, city and county public buildings. The Council estimates that total energy expenditures in the buildings surveyed approach $124 million per year. Limiting efficiency retrofits to those with paybacks less than six years, the investment of $80 million spread over a four-year period will save a total of $20 million per year or more according to EPC estimates -- once the work is completed.

The bonding program would make loans to public agencies to finance needed improvements, $10 million spent in each of the state and local government programs per year for four years (for a total of $80 million). Repayment, including interest costs, would be achieved through energy savings accrued with the energy efficiency measures.

The EPC anticipates that the avoided energy costs will yield a positive cash flow for the public bodies in the first year of the program. The EPC also believes that the bonded indebtedness would be totally repaid within five years of the issuance of each bond. By the ninth year of the program, then (five years after the issuance of the fourth set of bonds), the entire obligation of the state would be retired.

Adapting the multiplier analysis to the Iowa bonding proposal as shown in the following table, and assuming that energy costs rise no more than 8% annually with the inflation rate hovering around 5% over a ten year period, we can set up a comparison of the economic returns to the state with and without the efficiency improvements. To establish a meaningful inter-year comparison, all results are presented in discounted 1985 dollars.

Setting 1985 as the baseline year, identified as "year zero" in the table, we find that the state's energy expenditures for public buildings ($124,400,000) produces an economic return of $160 million. As energy bills claim a greater portion of the state and local government revenues, however, money is pulled from more economically productive uses such that, by the end of the first year economic activity is actually less than the baseline results. Again, these results are in discounted 1985 dollars.

Contrasting the "business-as-usual" scenario with expected results from the bonding program, we find an improvement in the overall economic health of the state. In year one, for instance, the infusion of $19 million into an energy retrofit program (i.e., $20 million discounted by 5%), yields an economic return of $213 million for the state. This is an increase of more than $50 million compared to the baseline scenario.

Similarly, in year ten when the entire indebtedness has been retired, the state and local government's energy expenses will have been reduced by $26.5 million (1985 dollars) compared to the baseline scenario. This positive shifting of revenue to more productive uses increases the state's economic activity from $160 million to $241 million -- a 50% increase in ten years.

This comparison of the two revenue streams, using relevant multiplier analysis, shows the bonding proposal to be an excellent economic redevelopment tool which can, in both the long and the short run, also reduce the fiscal pressures on state and local governments.

Table 3-5

A LOOK AT THE COMPARATIVE ECONOMIC IMPACTS OF ENERGY USAGE IN IOWA PUBLIC BUILDINGS 'WITH' AND 'WITHOUT' CONSERVATION RETROFITS

PART I. INPUT VARIABLES FOR IOWA ANALYSIS

MULTIPLIERS	
disposable income	2.37
energy	1.29
conservation	2.38
finance	1.83

Annual Rate of Cost Increase	.08	
Annual Discount Rate-Inflation	.05	
Bond Loan Period - years	5	per issuance
Conservation Retrofit Costs	20,000,000	per issuance
Baseline Energy Costs	124,000,000	for all buildings
Energy Costs with Conservation	104,400,000	for all buildings
Yearly Bond Payments	5,280,000	per issuance
Period of Study	10	

Table 3-5 (Continued)

II. DISPLAY STUDY RESULTS FOR IOWA PUBLIC BUILDINGS RETROFIT ANALYSIS (1985 dollars)

Activity	Year Into Investment	Capital Cost	Energy Cost	Bond Payments	Energy Savings	Income Shift	Net Economic Activity
space conditioning w/o conservation							
in year	0	0	124,400,000	0	0	0	160,476,000
in year	1	0	127,954,286	0	0	-3,554,286	156,637,371
in year	4	0	139,238,138	0	0	-14,838,138	144,450,811
in year	10	0	164,878,841	0	0	-40,478,841	116,758,852
with conservation							
in year	0	0	124,400,000	0	0	0	160,476,000
in year	1	19,047,619	122,811,429	5,028,571	5,238,095	209,524	213,548,933
in year	4	16,454,049	116,852,585	17,375,476	22,385,553	5,010,076	233,571,475
in year	6	0	123,625,265	11,820,052	26,051,302	14,231,250	214,835,350
in year	10	0	138,370,989	0	26,507,852	26,507,852	241,322,185

3.6 COMMUNITY ENERGY ANALYSIS IN NEBRASKA

The Nebraska Energy Office (NEO) uses multiplier analysis as one of the tools in its Nebraska Community Energy Management Program, or NCEMP. In each community it is invited to work, the NEO returns a report to a local energy committee which outlines energy usage patterns in the area and discusses the economic impacts of that usage. Key to understanding the relationship between energy and the community economic well-being is a comparison of local productivity under a "business-as-usual" scenario in the year 2000 versus an energy management scenario. In the latter scenario it is assumed that a community-wide energy management effort will result in a 30% reduction in total energy usage over 1985 consumption levels.

To illustrate how multiplier analysis can be used in a community program, this report has adapted information from a current NCEMP town, West Point. The cumulative energy usage of this 3,600 population town presently runs about 734.5 billion Btus. The annual energy bill of the entire community--including costs of gasoline, electricity and natural gas--is $5.7 million, approximately $1,600 per capita. Assuming average energy price increases of only three percent above inflation by the year 2000, West Point's annual energy bill will climb to $8.92 million (1985 dollars), even if consumption remains at the 1985 level. This represents a 56% increase. Spending more of the West Point business and family budgets on energy means there will be less money for the purchase of other goods and services.

Adapting information from Table 2-4 of this study, we find that the weighted multiplier of West Point's energy purchases is 1.36. As previously noted, the Region VII equivalent household multiplier is 2.37. Combining this information with the above energy consumption data for West Point, we can look at the impact future energy bills will have on the local economy by comparing the business-as-usual scenario results with the energy management approach as illustrated in Table 3-6.

If the higher energy prices projected in Table 3-6 do occur, each dollar of the $3.19 million increase "costs" the economy about $1.01 in lost productivity. In other words, instead of a return of $2.37 for each dollar spent, West Point's economy will earn only $1.36 for every dollar directed from business and family budgets to pay the higher energy bills. In the year 2000, then, a $3.19 million increase in the overall energy bill implies that West Point will contribute approximately $3.22 million less to the Gross State Product. In per capita terms, the productivity in the year 2000 will be lowered by $892 per resident (1985 dollars).

Pursuing an energy management scenario -- in this example, one that lowers energy usage by 30% over the 1985 level -- indicates that compared to the business-as-usual in the year 2000, energy efficiency can generate an increase of $2.69 million in local economic activity. This suggests that community-wide energy management efforts can provide a major boost to local economic redevelopment efforts in West Point. One interesting note, however, is that in absolute terms -- comparing the year 2000 to the baseline year of 1985 -- as long as the rae of energy price increases rises faster than the rate of conservation efforts, local economic productivity will be weakened. This is because any shift of income away from normal consumer expenditures to high energy bills represents roughly a dollar for dollar loss. Energy management, then, may also be viewed as the only measure which can significantly offset lost productivity from future energy costs.

TABLE 3-6

ECONOMIC CONTRAST BETWEEN BUSINESS AS USUAL AND ENERGY MANAGEMENT SCENARIOS IN WEST POINT, NEBRASKA (population 3,600)

	Business-As-Usual		Energy Management (30 Percent Reduction)	
	Consumption (billion BTUs)	Costs (million 1983 $)	Consumption (billion BTUs)	Costs (million 1983 $)
1985	734.5	$5.73	734.5	$5.73
2000	734.5	8.92	514.2	6.25
Net increase in 2000 energy bill		3.19		0.52
Loss to economy as a result of expenditures in excess of 1981 costs		-3.22		-.52
Gain to economy as a result of 30% conservation compared to business-as-usual scenario in year 2000				+2.69

4.0 TECHNICAL SUPPLEMENTS

This supplement is appended to provide the reader with the main body of technical data used to generate the co-efficients and indicators presented in the previous sections. Those persons or agencies who wish to develop estimates of impacts similar to those contained in section three will find the information here a useful guide in identifying and tracking the data needed as inputs for such efforts.

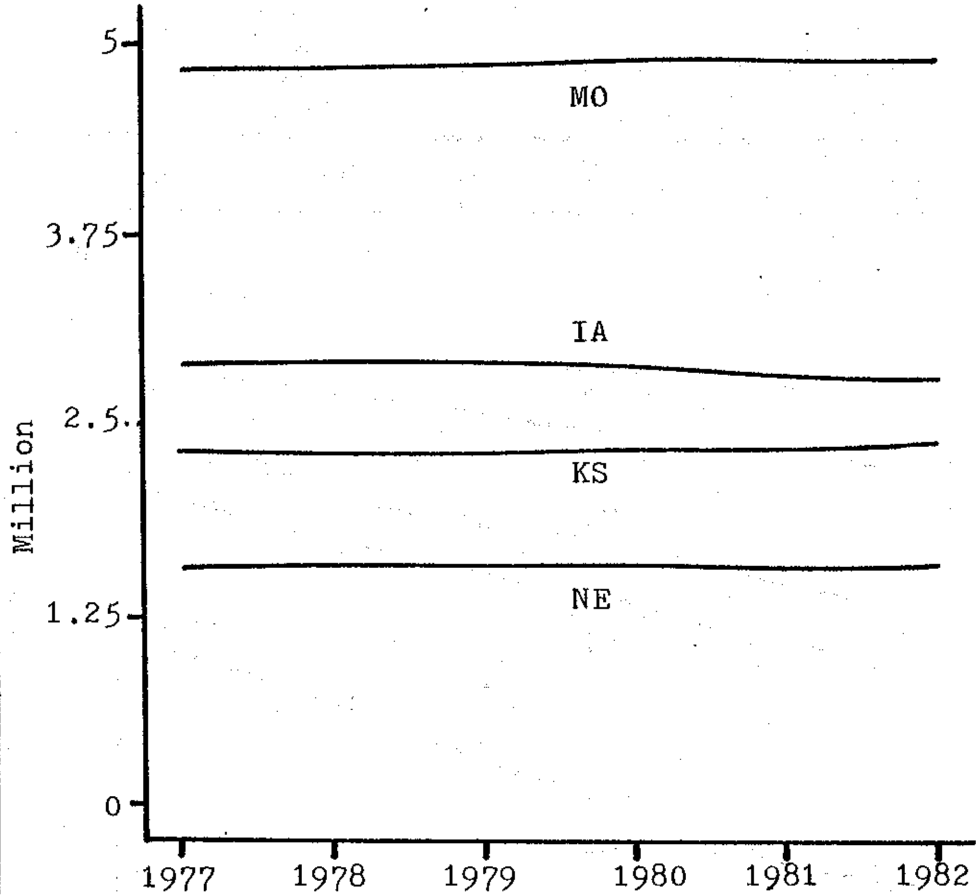
4.1 DEMOGRAPHIC DATA

Among the most important data necessary to review impacts of structural changes in the economy are those for population and personal income trends.

Generally, there has been relatively slow population growth within the Region. Iowa has actually experienced a net population decline between 1977 and 1982. Kansas has grown more rapidly with a 3.9 percent increase over this period. Overall, this Region has experienced slower population growth than the nation as a whole.

The illustration on the next page highlights the growth in personal income in current dollars between 1977 and 1982. The Region experienced greater income growth than the nation. Kansas registered the greatest growth followed by Nebraska, Missouri, and Iowa. Kansas has the highest per capita income level and Missouri has the lowest. Overall, the per capita income level for the states within this Region is somewhat lower than the national average, but not significantly so.

POPULATION, 1977-1982



Percent Change 1977 to 1982	
U.S.	5.5
R7	1.9
IA	-0.3
KS	3.9
MO	2.2
NE	2.1

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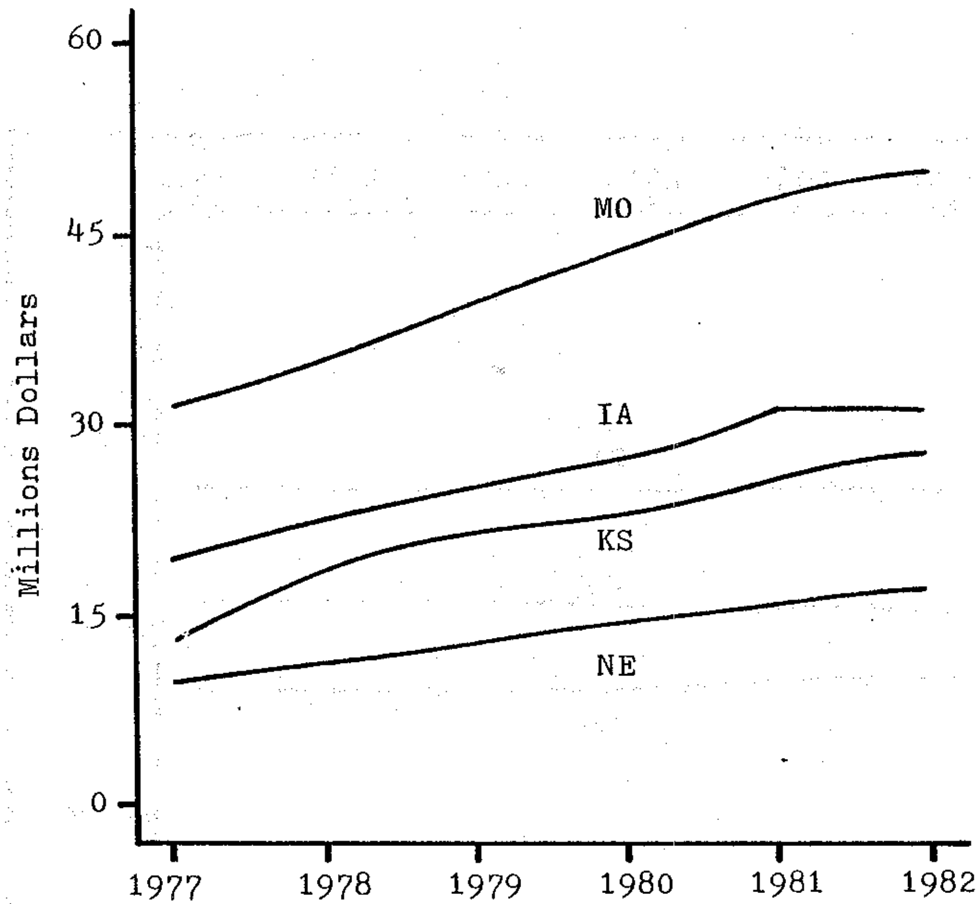
PERSONAL INCOME, 1977-1982



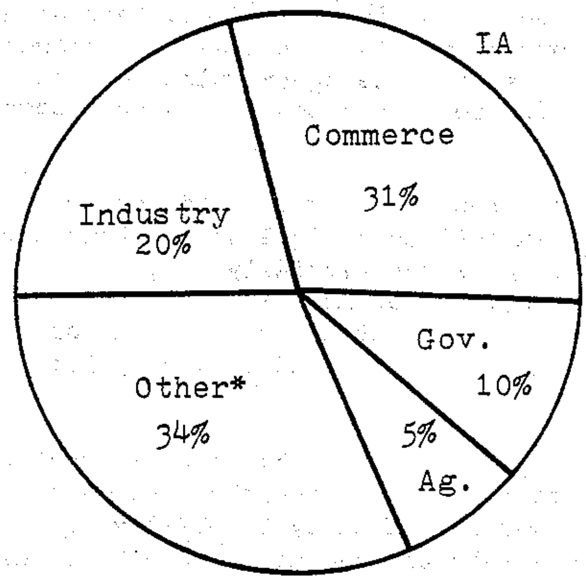
Percent Change 1977 to 1982	
U.S.	58
R7	61
IA	57
KS	72
MO	58
NE	64

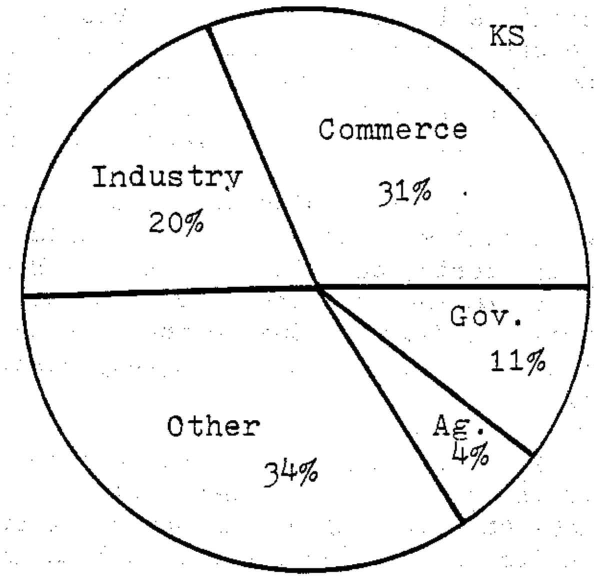
Per Capita 82 Income	
U.S.	11,109
R7	10,655
IA	10,791
KS	11,765
MO	10,170
NE	16,939

Dollars

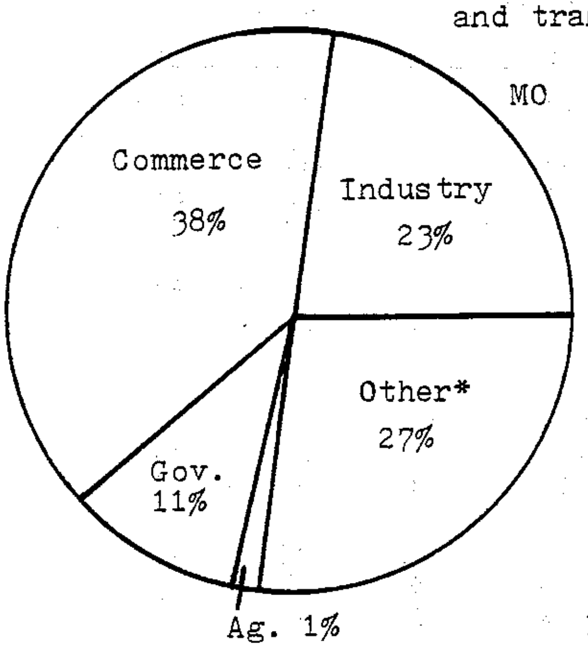
DWM 10-84

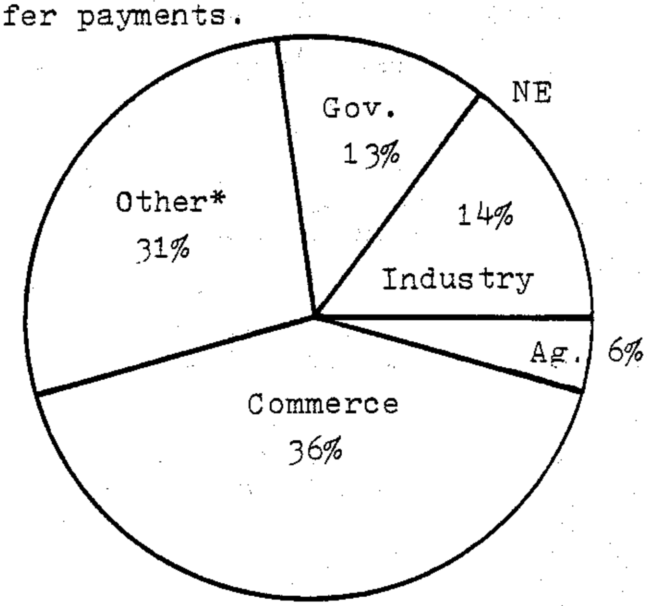
1982 PERSONAL INCOME BY SECTOR





*other income includes non-labor income such as rents, dividends, interest, and transfer payments.





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The series of pie charts displays the source of personal income by state in 1982. Despite the relative importance of agriculture in all four states, agriculture as a direct source of income is the smallest of the major economic sectors. Commerce, which includes retail and wholesale trade, services, finance, insurance, communications, real estate, transportation and private utilities is generally one of the largest sources of income. Consistent with the national trend, commerce is offering some of the fastest areas of income growth. Another large source of income is the other category which includes transfer payments (i.e. social security, medicare, etc.) and non-labor income (i.e. interest and stock income, and rents).

Structurally, Missouri is more dependent upon industry than the other three states. Industry in this case has been defined to include construction, manufacturing and mining. Clearly Missouri has a substantially larger manufacturing base than the other three states. Government income is somewhat larger in Nebraska due to the existence of public electric and natural gas utilities. Nebraska is the only state in the Union with 100 percent public power.

The following table provides the period percent change by economic sector for the four states. These values were determined by taking the 1982 value minus the 1977 value and then dividing the derived value by the 1977 value. The dta in this table provides some insights into the causes of growth or the lack of it during this period by state.

Table 4-1 PERSONAL INCOME PERCENT CHANGE -- 1977 to 1982

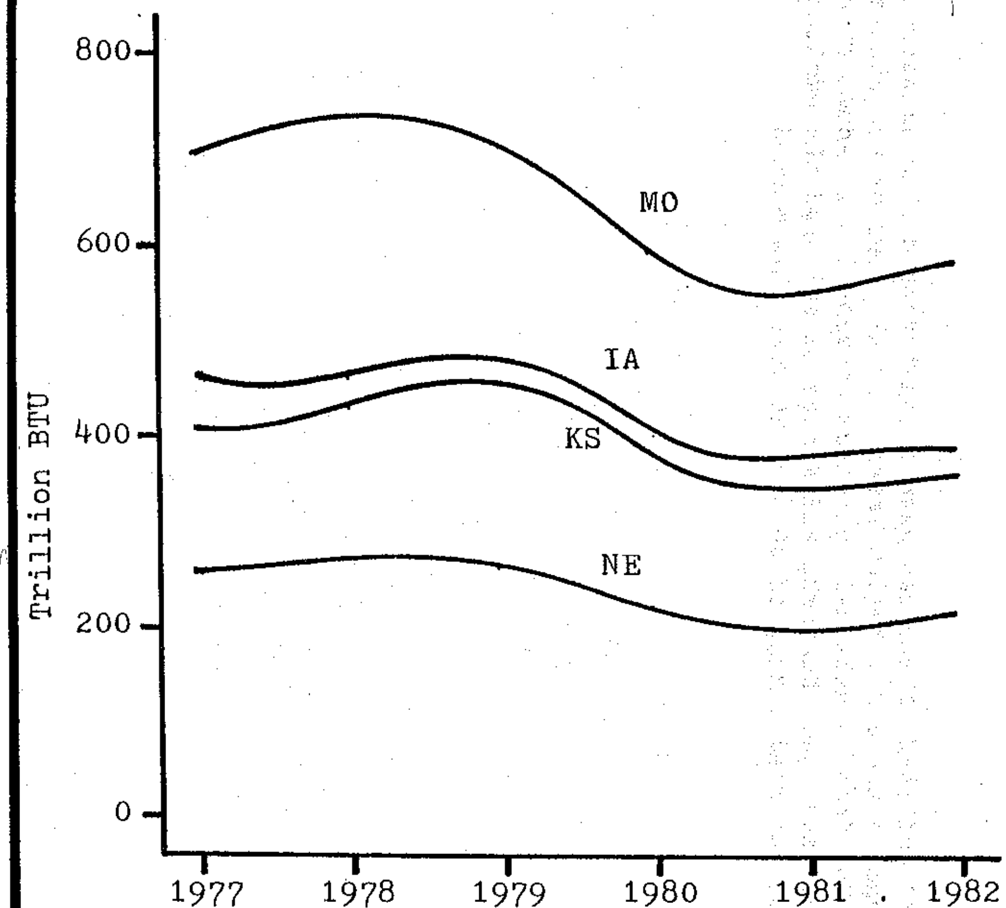
Economic Sector	IA	KS	MO	NE
Total	57	72	58	64
Farm	37	75	-44	55
Mining	8	131	31	58
Construction	2	26	30	NC
Manufacturing	32	58	38	47
Transportation	43	53	37	59
Communications	54	88	89	72
Utilities	46	79	67	96
Wholesale Trade	52	68	55	56
Retail Trade	31	43	32	34
FIRE	48	54	50	57
Services	63	75	67	66
Government	46	58	45	59
Transfer Payments	86	85	77	80
Non-Labor Income	112	115	120	111

Values are in percent
FIRE - finance, insurance, and real estate
Non-Labor income - rents, interest, and dividends

4.1 PETROLEUM ANALYSIS

Between 1977 and 1982, there has been a consistent declining petroleum consumption trend in the U.S., Region Seven, and all four of the states within Region Seven. The drop in national petroleum consumption is somewhat greater than the Regional average. Nebraska and Kansas experienced the smallest decline and Iowa recorded a drop of 20 percent over this period.

PETROLEUM CONSUMPTION, 1977-1982 (1)



Percent Change 1977 to 1982

US	19%
R7	18
IA	20
KS	14
MO	17
NE	14

1982 Per Capita Petroleum Use

US	130%
R7	126
IA	128
KS	145
MO	115
NE	128

Million BTU.

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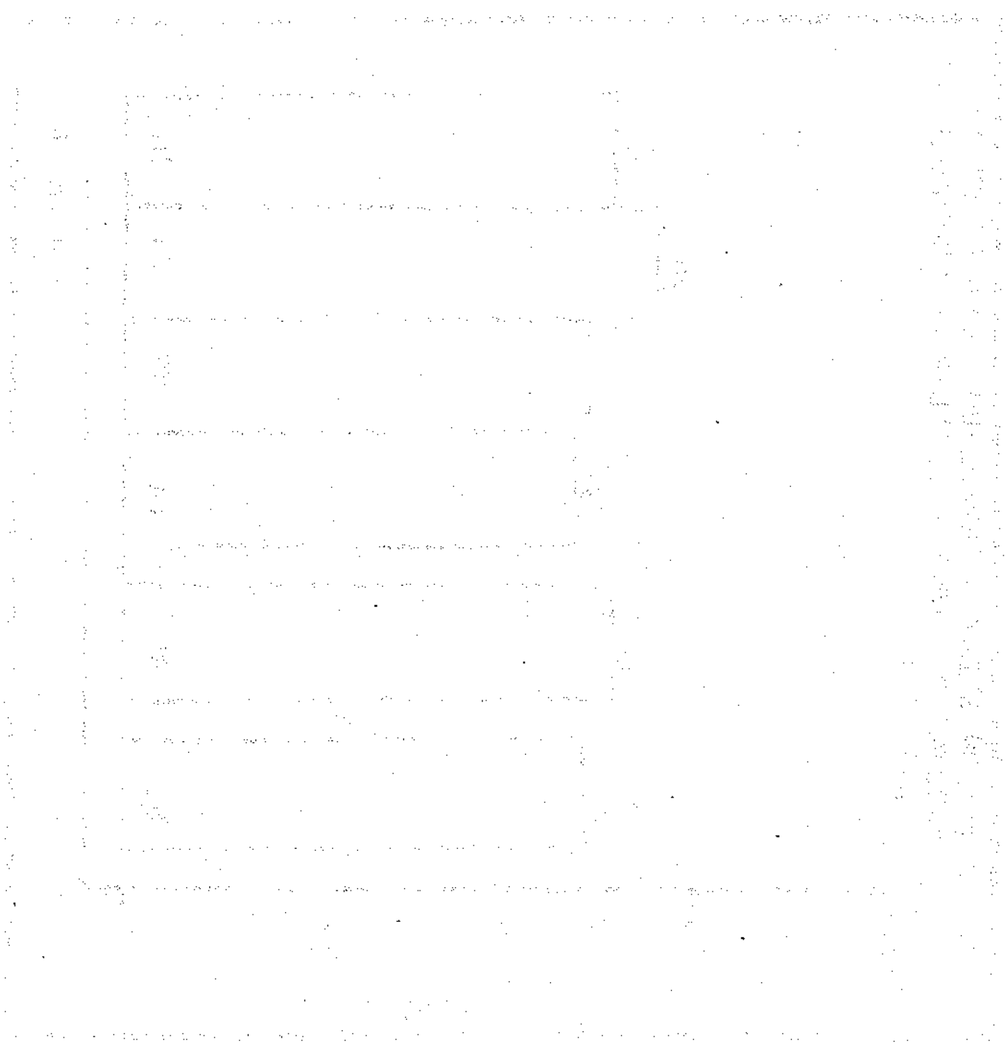
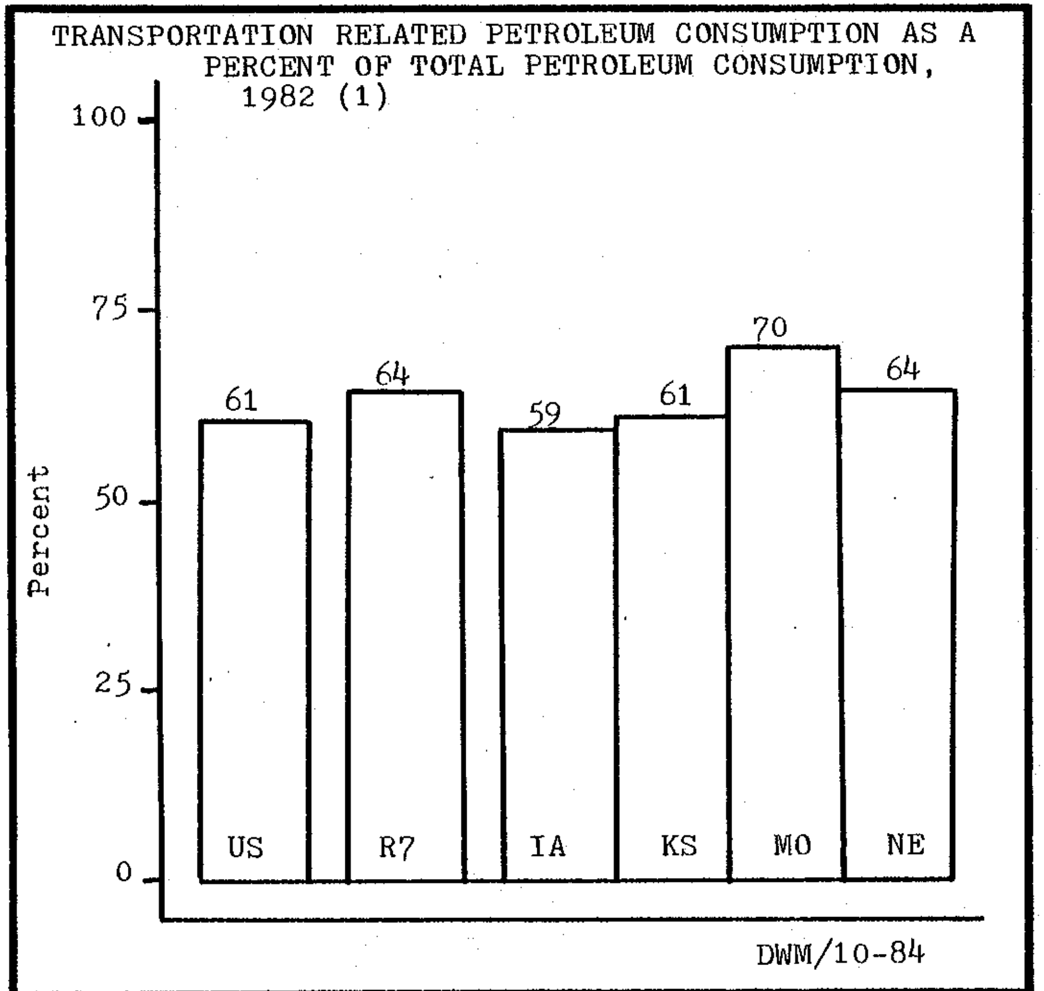
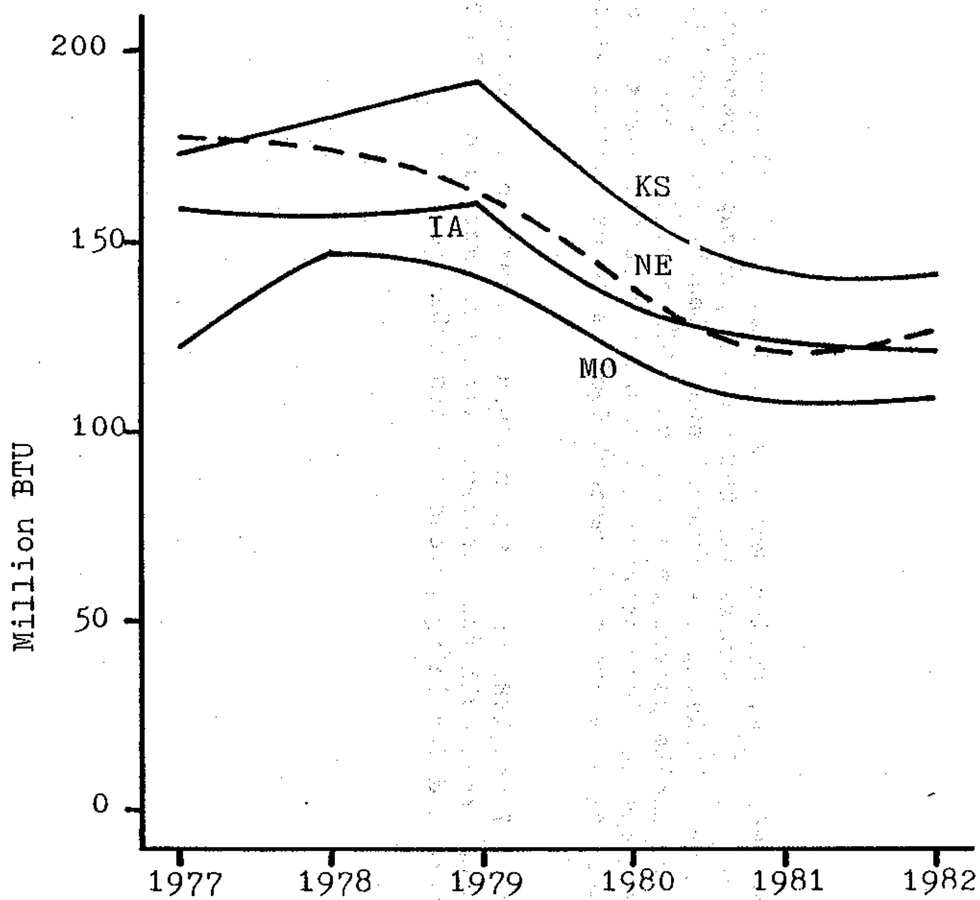
As the illustration below highlights, a significant majority of the petroleum consumed by the states in this Region is used in transportation. The use of petroleum for transportation is somewhat greater in Region Seven than it is nationally. Missouri has the highest percentage of petroleum used in transportation.




TRANSPORTATION RELATED PETROLEUM CONSUMPTION AS A PERCENT OF TOTAL PETROLEUM CONSUMPTION, 1982 (1)
Percent
100
75
50
25
0
61
64
59
61
70
64
US
R7
IA
KS
MO
NE
DWM/10-84

PER CAPITA PETROLEUM CONSUMPTION, 1977-1982 (1,4)



Percent Change 1977 to 1982	
US	-22%
R7	-19
IA	-20
KS	-16
MO	-6
NE	-28

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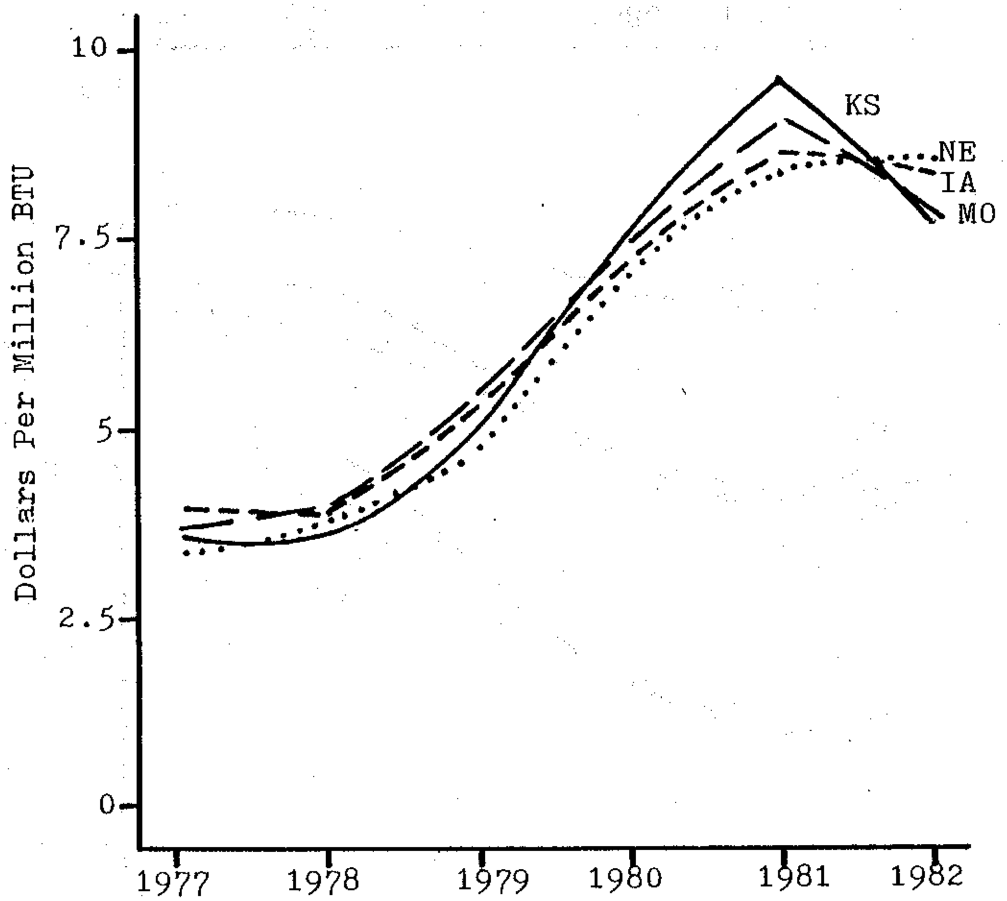
Based on 1982 data, Region Seven is somewhat less petroleum dependent than the nation as a whole. Kansas has the highest per capita petroleum consumption level with Missouri having the lowest level. Generally, there has been a decline in per capita petroleum usage over this period. However, the rates of change vary among the four states. Missouri registered a six percent decline while Nebraska experienced a 28 percent decline in per capita petroleum consumption.

Between 1977 and 1981 there was a rapid increase in the retail price of petroleum products in all four states. With the exception of Nebraska, the Region experienced declining prices between 1981 and 1982.

AVERAGE RETAIL PETROLEUM PRICES, 1977-1982 (2,3)



Percent Change 1977 to 1982

US	138
R7	116
IA	116
KS	105
MO	118
NE	129

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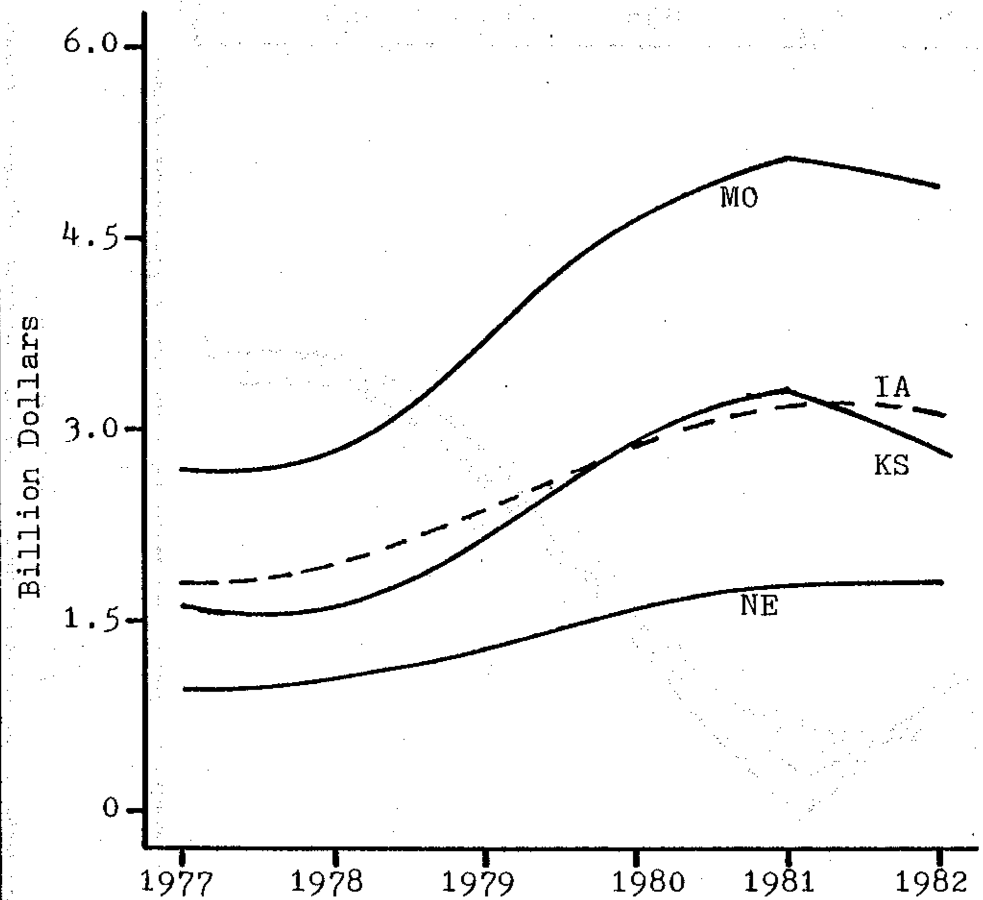
EXPENDITURES FOR PETROLEUM PRODUCTS, 1977-1982 (2,3)



Percent Change 1977 to 1982

US	114%[1]
R7	78
IA	74
KS	77
MO	81
NE	82

1) 1977-1981

1982 Per Capita Expenditures

US	$1256[1]
R7	1065
IA	1076
KS	1148
MO	997
NE	1126

1) 1981

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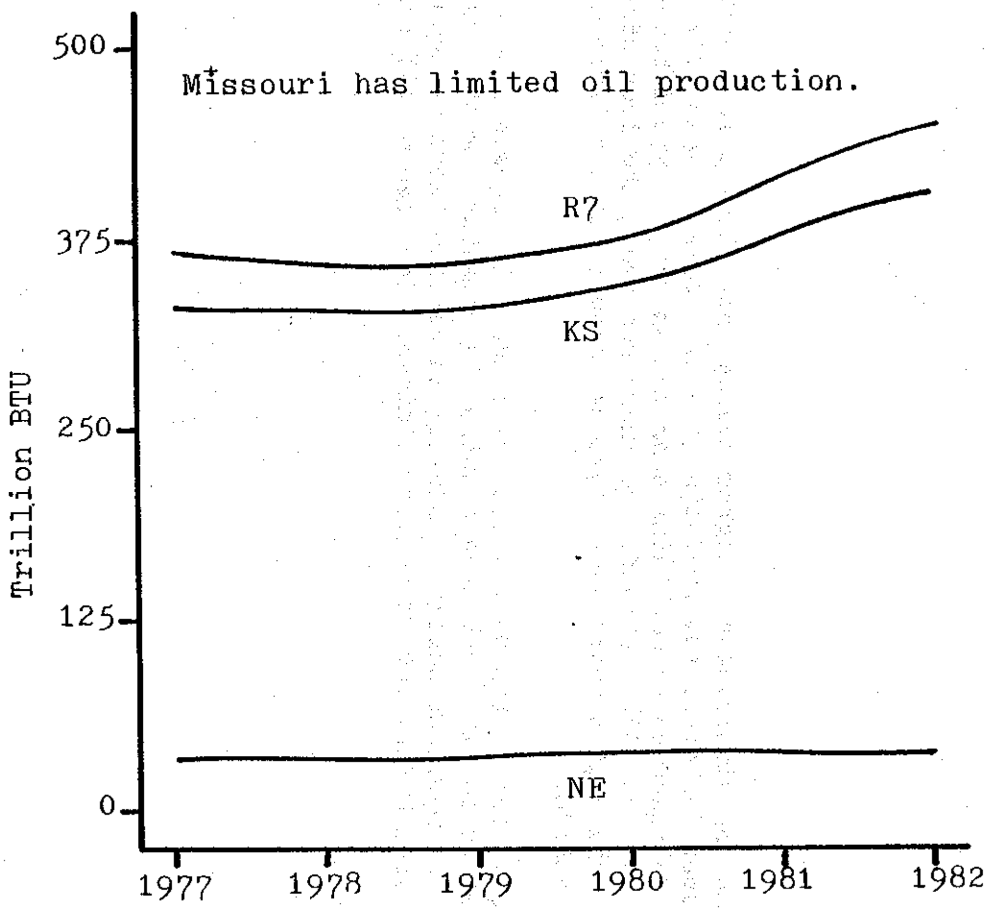
Reflecting significantly higher average petroleum prices over this period, expenditures for petroleum products generally rose between 1977 and the early 1980's. In response to declining consumption rates, expenditures moderated between 1981 and 1982. Expenditure increases among the four states were very similar. The Region experienced somewhat slower rates of expenditure growth than the nation.

Three states in the Region produce crude oil. Kansas produces significant volumes of crude oil. Nebraska's output is somewhat limited, but it forms the basis of an important substate industry in certain Nebraska counties. Missouri has some production, but it is very limited. Iowa has no oil production.

CRUDE OIL PRODUCTION, 1977-1982 (5)



Percent Change 1977 to 1982	
R7	18%
KS	23
MO	236
NE	14

Per Capita, 1982 Production	
R7	138
KS	170
MO	---
NE	25

Million BTU.

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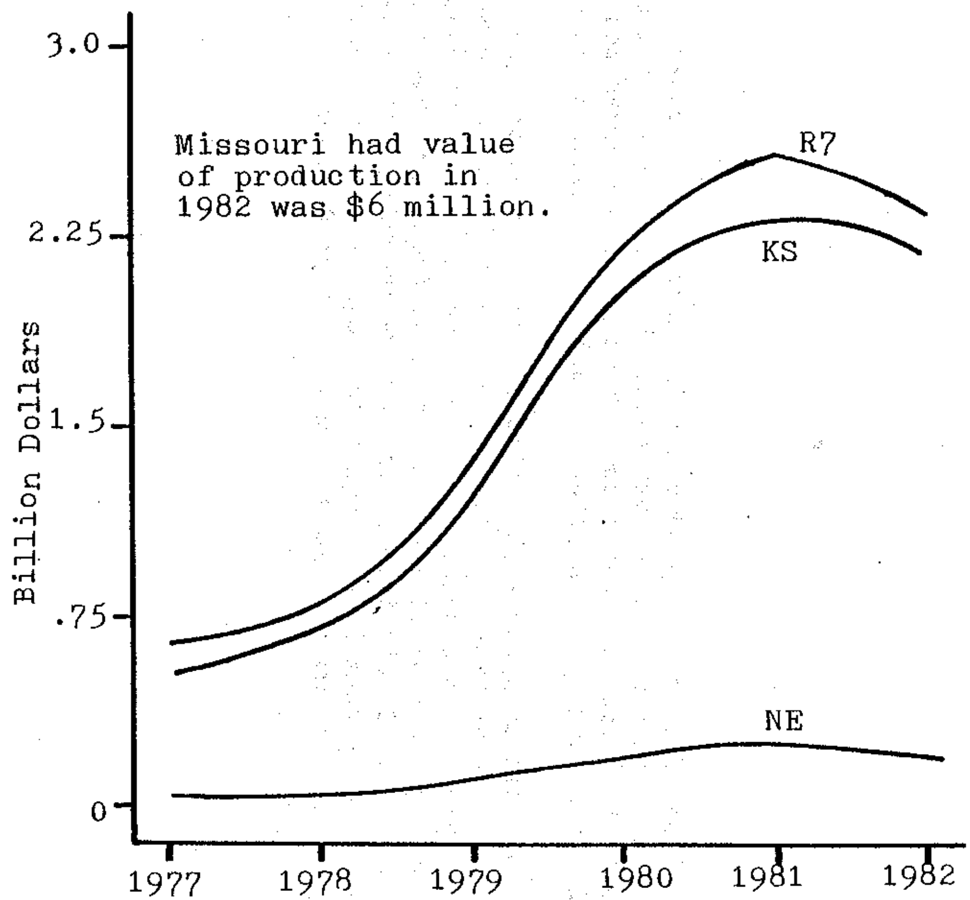
VALUE OF CRUDE OIL PRODUCTION, 1977-1982 (5)



Percent Change 1977 to 1982	
R7	275%
KS	278
MO	500
NE	244

1982 Per Capita Value of Prod.	
R7	$201
KS	905
MO	1
NE	133

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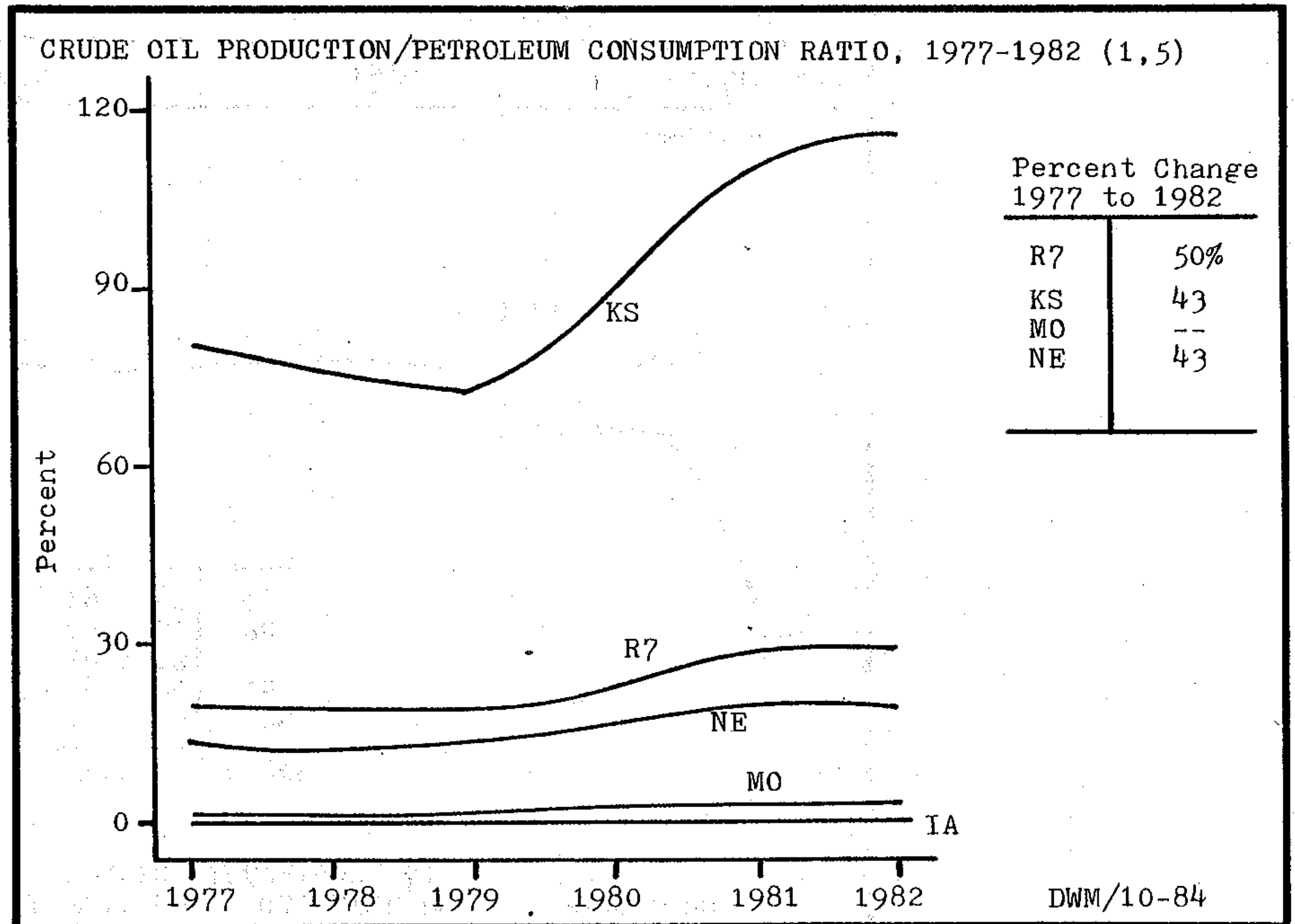
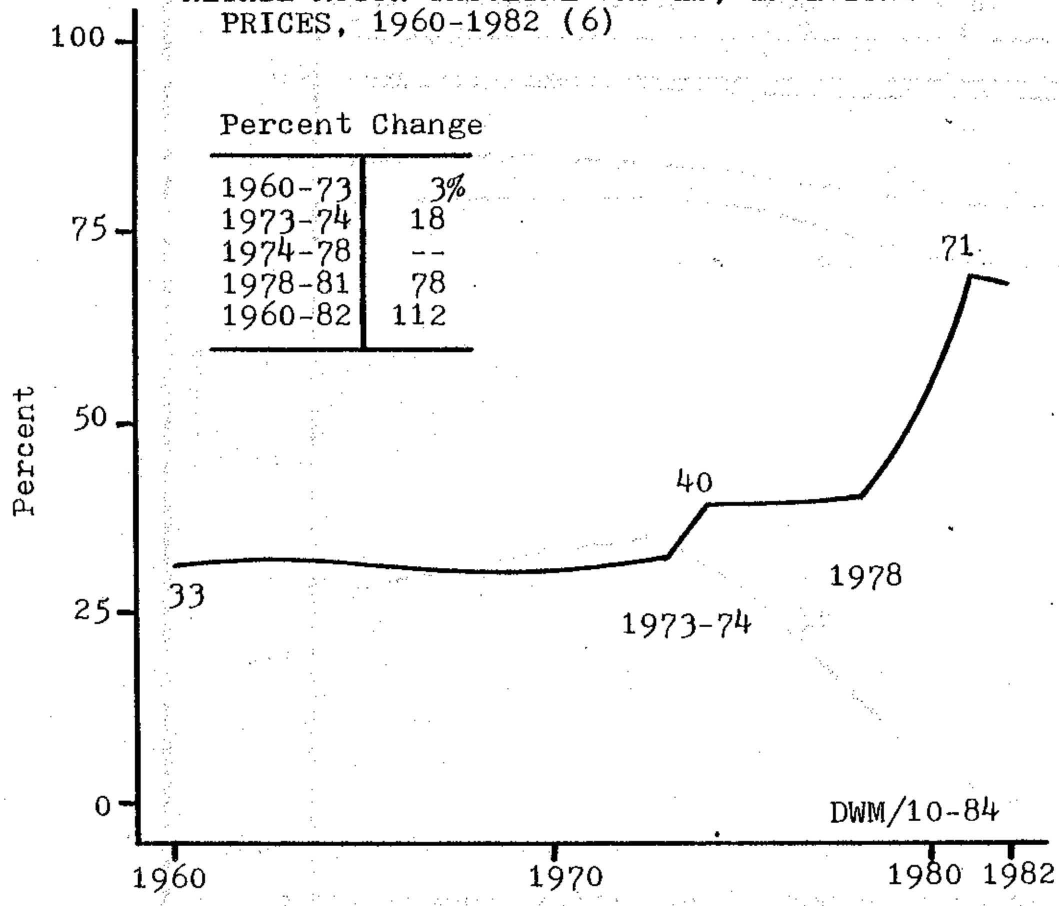
The value of crude oil production in Kansas and Nebraska rose dramatically during most of this period in response to higher wellhead prices and to a lesser extent, output improvements.. Value of output moderated between 1981 and 1982 reflecting dropping international and national crude oil prices.

In 1982, Kansas produced 17 percent more oil than it consumed. Consequently, Kansas was the only state in this Region which was a net oil exporter. Nebraska's production on an equivalency asis accounted for 20 percent of its own consumption. Missouri production provided less than one percent of its 1982 petroleum demand. Iowa depended totally on oil imports to meet its needs. Overall, the Region on a equivalency basis provided about 30 percent of its consumption needs from its own production.


CRUDE OIL PRODUCTION/PETROLEUM CONSUMPTION RATIO, 1977-1982 (1,5)
Percent
120
90
60
30
0
KS
R7
NE
MO
IA
1977
1978
1979
1980
1981
1982
Percent Change 1977 to 1982
R7 50%
KS 43
MO --
NE 43
DWM/10-84

U.S. WELLHEAD CRUDE OIL PRICE AS A PERCENT OF U.S. RETAIL MOTOR GASOLINE PRICES, EXCLUDING PRICES, 1960-1982 (6)

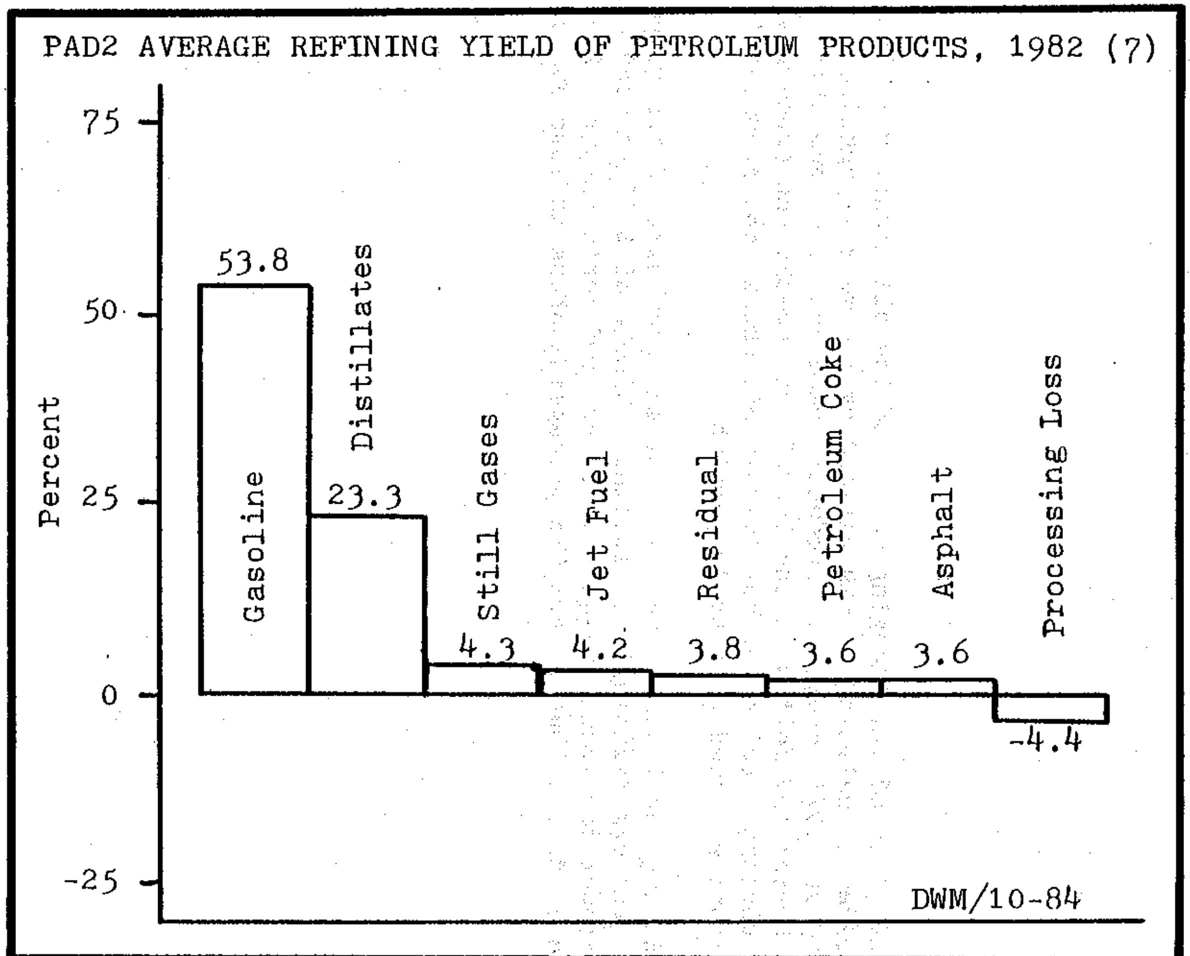


Percent Change

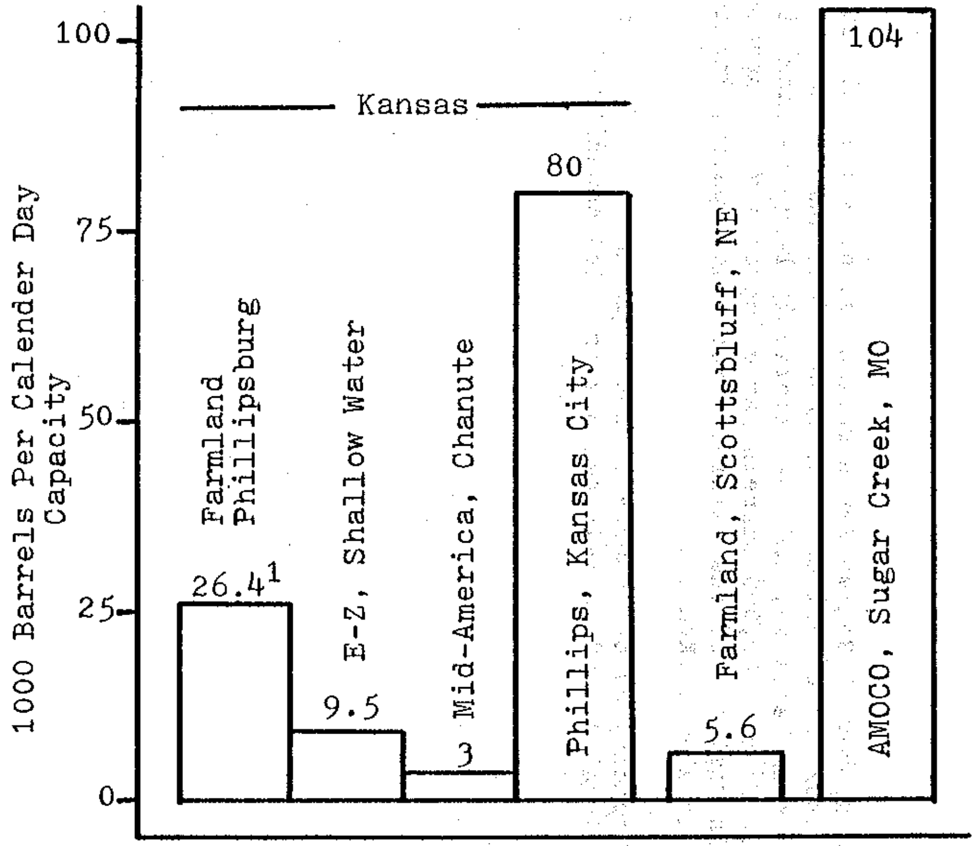
1960-73	3%
1973-74	18
1974-78	--
1978-81	78
1960-82	112

An important indicator of the changing nature of the oil industry is the percent value of crude oil wellhead prices divided by the retail gasoline price. Between 1960 and 1973, crude oil producers received about one-third of the retail price. During and following the 1973-74 oil shock, the producers' share jumped to 40 percent. Following the 1978-79 oil shock, the producers' share of the retail price jumped to over 70 percent.

Within oil producing sections of the Region Seven, over half of the output of a barrel of oil (through refining) is gasoline. Middle distillate products like diesel fuel account for about one-quarter of the refiner's output. About five percent of the crude oil that enters the processing phase is loss due to inefficiencies.


PAD2 AVERAGE REFINING YIELD OF PETROLEUM PRODUCTS, 1982 (7)
Percent
75
50
25
0
-25
Gasoline
53.8
Distillates
23.3
Still Gases
4.3
Jet Fuel
4.2
Residual
3.8
Petroleum Coke
3.6
Asphalt
3.6
Processing Loss
-4.4
DWM/10-84

REFINERIES SHUTDOWN, 1982 (7)



1) reopened in 1983.

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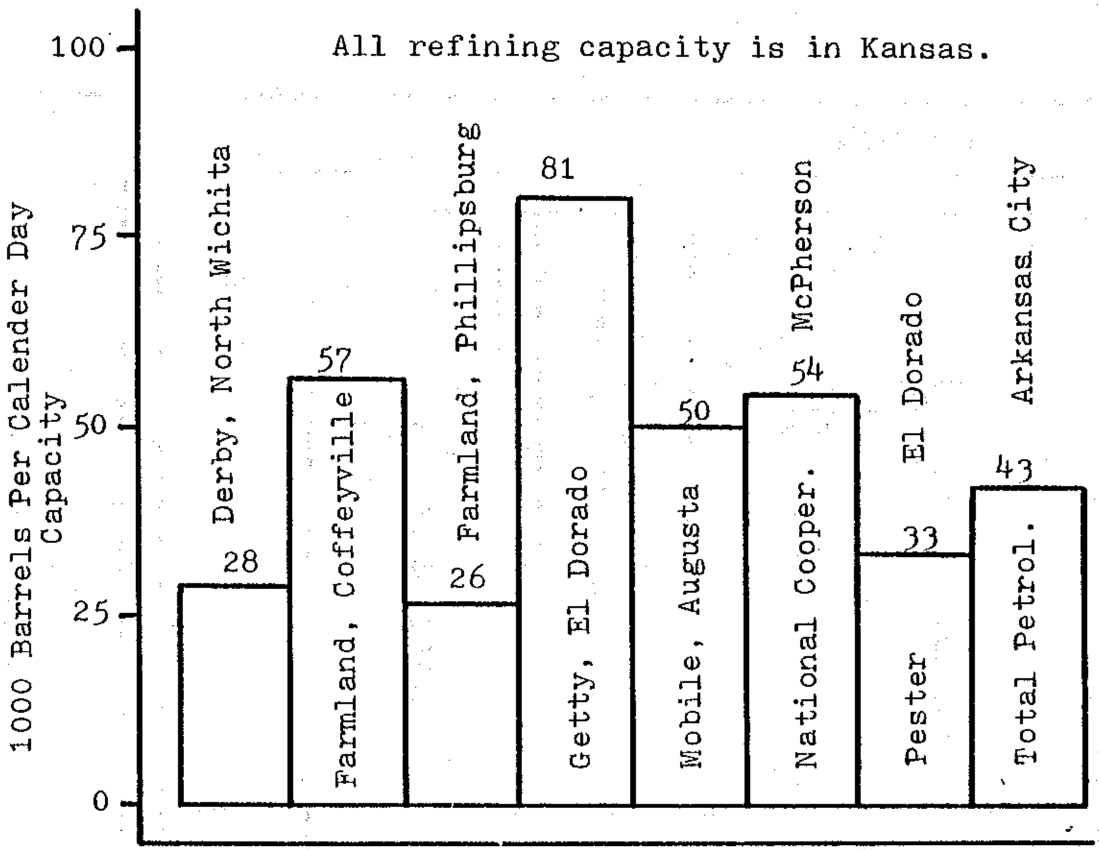
In recent years a number of Region Seven refineries have been closed by their operators. In 1982, four refineries in Kansas (one has subsequently reopened), one refiners in Nebraska, and one relatively large refinery in Missouri have closed. Nearly 200,000 barrels per calender day of capacity have been lost in this Region. Of the remaining refining capacity within the Region, all of it is located in Kansas.

Total operating capacity as of January 1, 1983 equalled 326,000 barrels per day with an additional 45,000 barrels per day in idled capacity.

CAPACITY OF OPERABLE PETROLEUM REFINERIES AS OF 1-1-83
(7)



Total operating capacity....326,000 barrels/day.
Total capacity that is idle...45,000 barrels/day.
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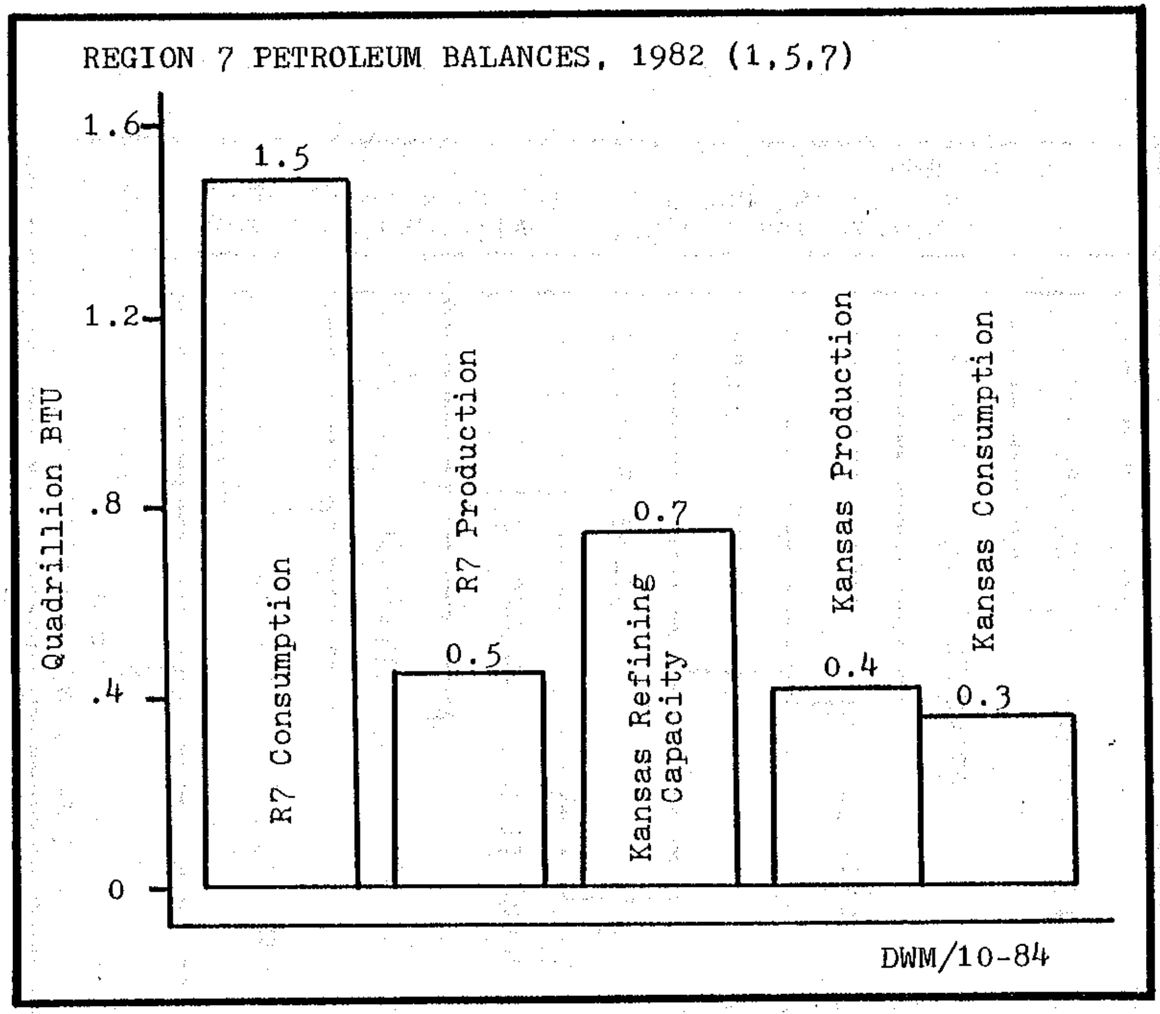

REGION 7 PETROLEUM BALANCES, 1982 (1,5,7)
Quadrillion BTU
1.6
1.2
.8
.4
0
1.5
R7 Consumption
0.5
R7 Production
0.7
Kansas Refining Capacity
0.4
Kansas Production
0.3
Kansas Consumption
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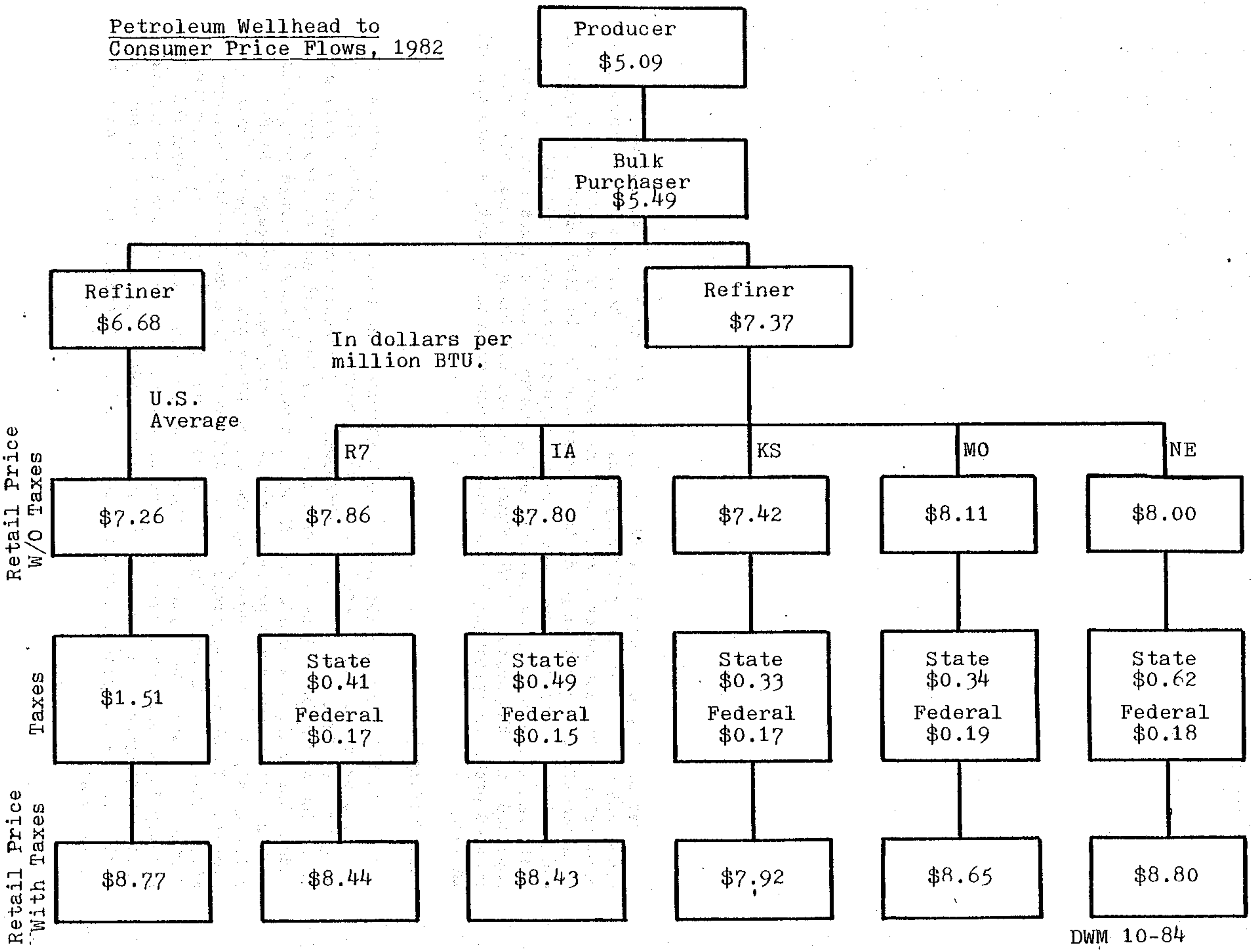
Overall, Region Seven in 1982 had 1,500 trillion BTU of petroleum consumption. The Region, primarily Kansas, had 500 trillion BTU of crude oil production. The Region or Kansas had the capacity to refine about 700 trillion BTU of petroleum products. Consequently, in 1982 about two-thirds of the Region's petroleum needs were dependent upon imported crude oil. Additionally, over half of the refined petroleum product needs were probably imported into the Region. Only Kansas had net surpluses of crude oil and refined products (production - consumption and refined capacity - consumption) in 1982.

Cost Coefficients

The illustration on the next page highlights the retail price margins for selected stages in the petroleum product supply system. Generally, the weighted (by fuel type and price differentials) average petroleum retail price in Region Seven in 1982 is somewhat lower than the national average price. Within the Region, Nebraska and Missouri have the highest average petroleum prices, while Iowa has a price comparable to the Region average. Kansas' price is significantly lower than the other three states or the national average. In part, these retail price differences are due to three factors. First, there are different degrees of relative petroleum product consumption, particularly when the Region and the nation are considered. For example, greater dependence on relatively more expensive gasoline versus less expensive fuel oil (Regional case versus the national case). Second, inherent supply system cost and structural differences. Third, different levels of state and local taxes.

Petroleum Wellhead to Consumer Price Flows, 1982

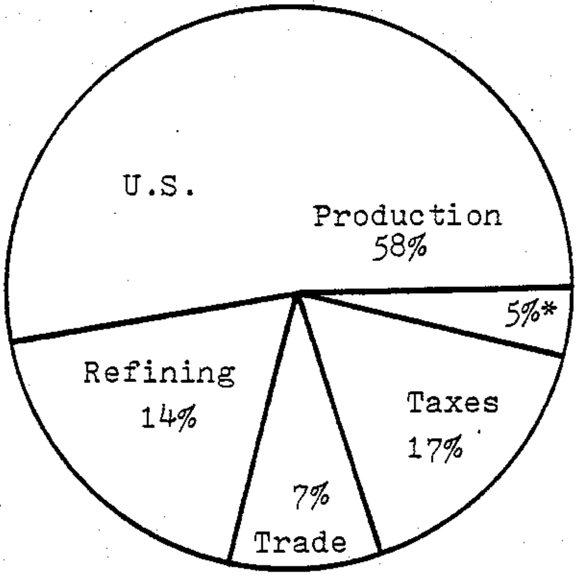


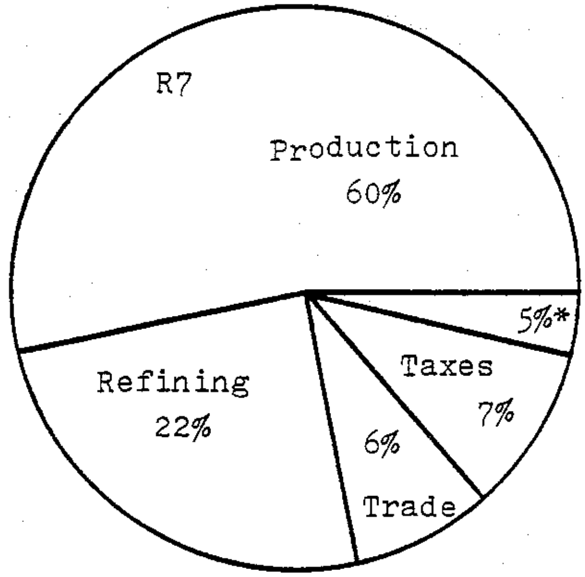
Cost Alocations

The pie charts on the next page highlight how a dollar spent by consumers nationally and in the four states for petroleum products is allocated among the various elements of the supply system.

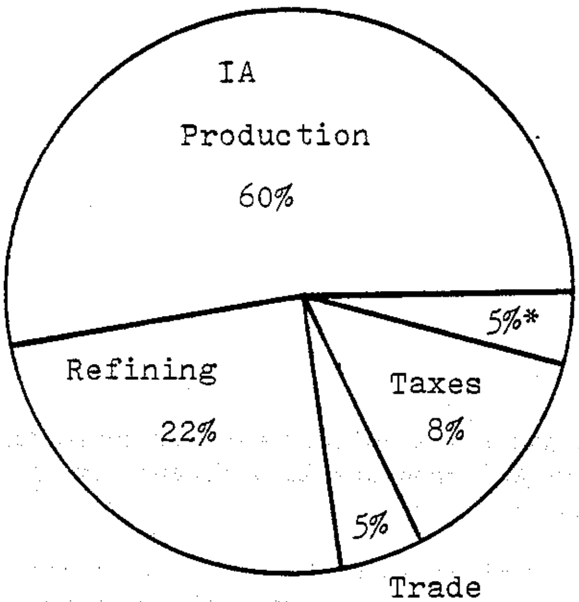
Nationally, about 58 cents on the dollar flows into the accounts of the petroleum producer and his/her financers. About 14 cents per dollar is the gross income margin for the oil refiner. Another five percent of these expenditures enters the accounts of the bulk purchaser -- the wholesaler who links up producers and refiners together. Another seven cents per dollar goes to wholesale and retail providers -- pipelines, pipeline terminals, wholesale facilities, gasoline stations, fuel oil dealers, and LPG dealers. Finally, about 17 cents per dollar (retail dollar) is collected in taxes at the retail sale point.

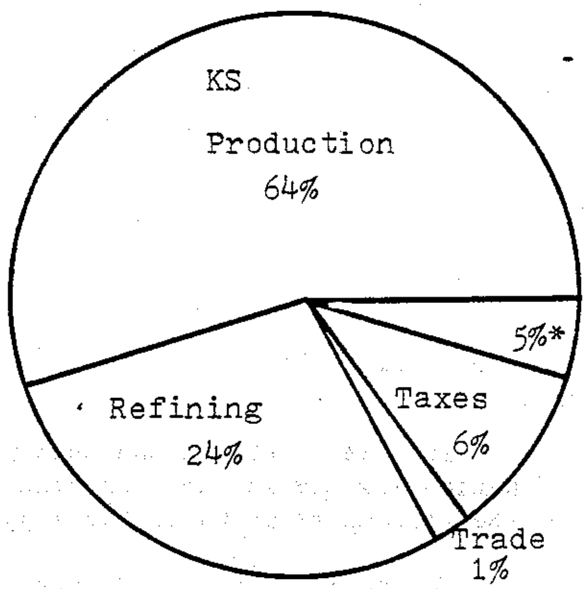
The Region tends to have a somewhat different distribution due to the factors already noted. About 60 cents per dollar flows to the producer segment, 22 percent to the refiners, five percent to the bulk purchasers, six percent to retail and wholesale providers, and seven percent to taxing authorities.



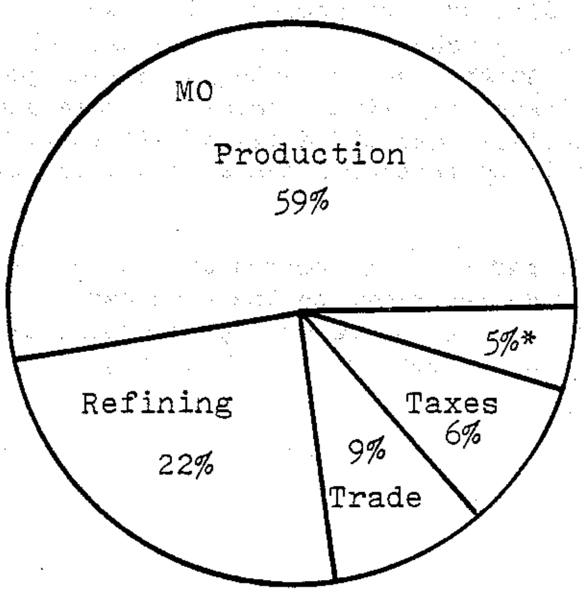


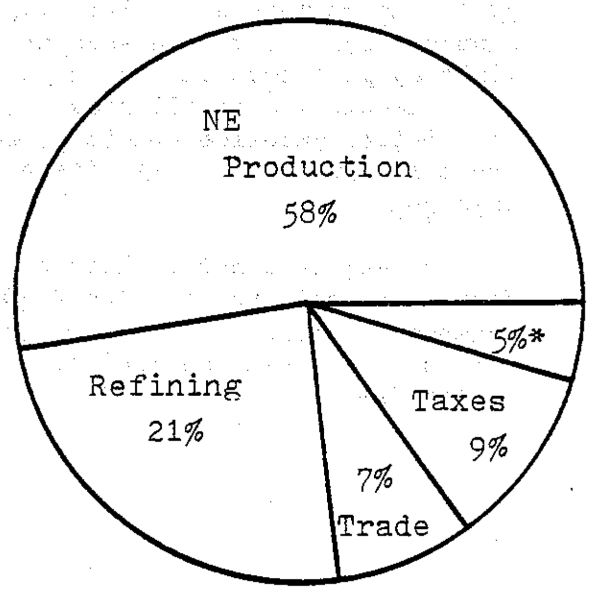
ALLOCATION OF PETROLEUM EXPENDITURES, 1982





*Bulk Purchaser





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10-84

Kansas has the highest percentage of the retail expenditure allocated to the producer -- 64 percent. The refiner takes another 24 percent and the retail and wholesale trade entities take the smallest share of one percent. This may be due in part to the direct refiner to retail outlet marketing in a state with a number of refineries. Nebraska has the lowest percentage allocated to the producer. This is primarily due to Nebraska's significantly higher motor fuels taxes.

Iowa and Missouri have somewhat similar allocations as the Region on whole. It is important to note that despite these differences, by and large all four states have similar cost allocation situations for 1982.

END NOTES TO THE PETROLEUM ANALYSIS SECTION

(1) State Energy Price and Expenditure Report 1970-1981. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, June 1984.

(2) State Energy Price Report, 1970-1982, Preliminary Draft. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, August 1984.

(3) State Energy Data Report. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, May 1984.

(4) Petroleum Supply Annual, 1982. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, June 1983.

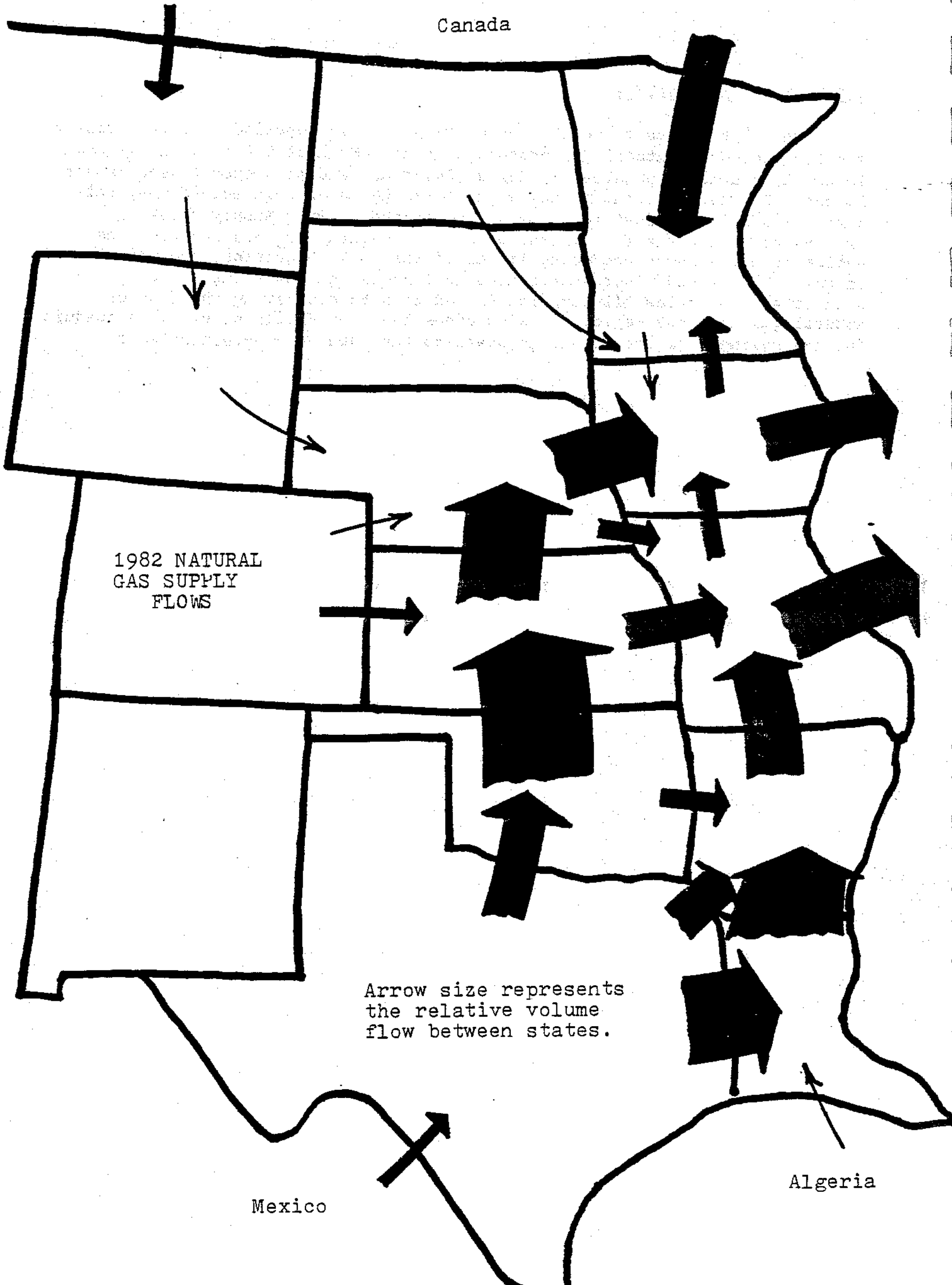
(5) Petroleum Marketing Monthly. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, monthly.

(6) Petroleum Supply Monthly. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, monthly.

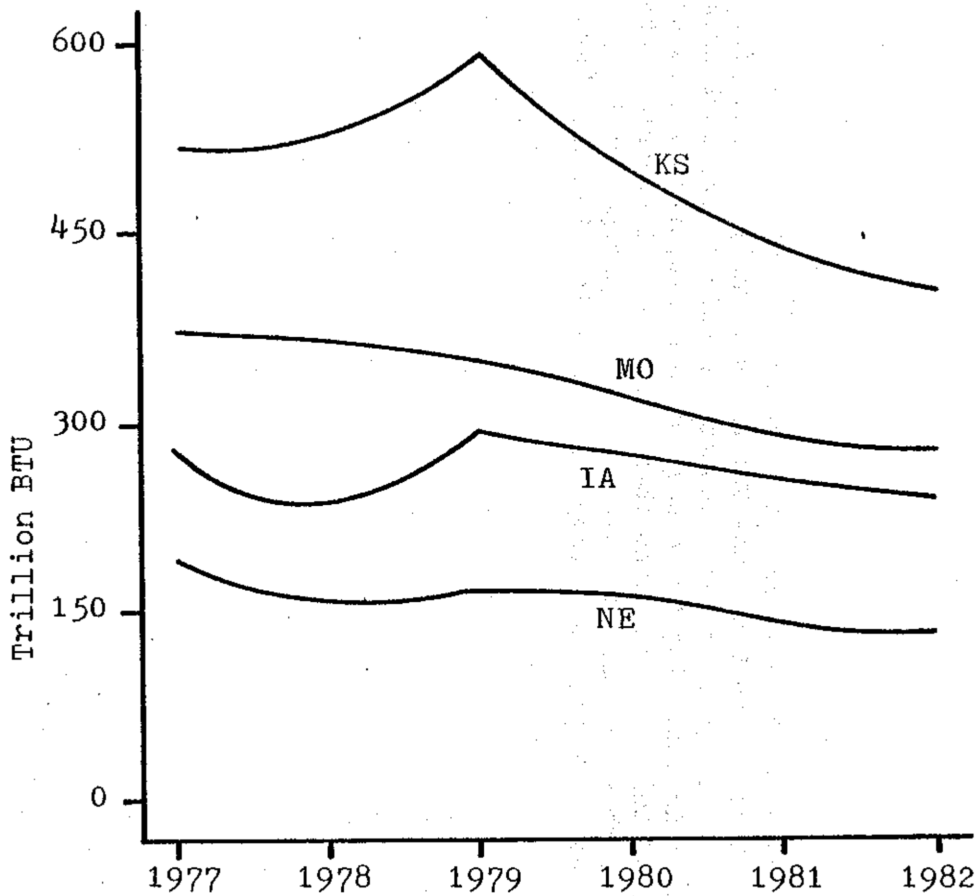
(7) Monthly Energy Review Washington, D.C.: Energy Information Administration, U.S. Department of Energy, monthly.

4.3 NATURAL GAS ANALYSIS

The four states of Region Seven are primarily supplied from two primary and two secondary natural gas producing areas. Much of the natural gas that enters this area is produced in Texas, Oklahoma, and to a much lesser extent Kansas. As the illustration below shows, in terms of relative volume, this supply track is the most important. The second primary supply track originates in Louisiana. Limited amounts of natural gas are entering the Region from the newer producing fields of the Rocky Mountains, including Canada. The second minor source area is Canadian gas entering the U.S. vis Minnesota. The below illustration in addition to displaying the flow of natural gas into the Region, it also shows that the Region serves as a conduit for gas moving from the producing areas to the upper Midwestern markets.


Canada
1982 NATURAL GAS SUPPLY FLOWS
Arrow size represents the relative volume flow between states.
Mexico
Algeria

NATURAL GAS CONSUMPTION, 1977-1982 (1)



Percent Change 77-82	
U.S.	-7
R7	-21
IA	-15
KS	-21
MO	-23
NE	-26

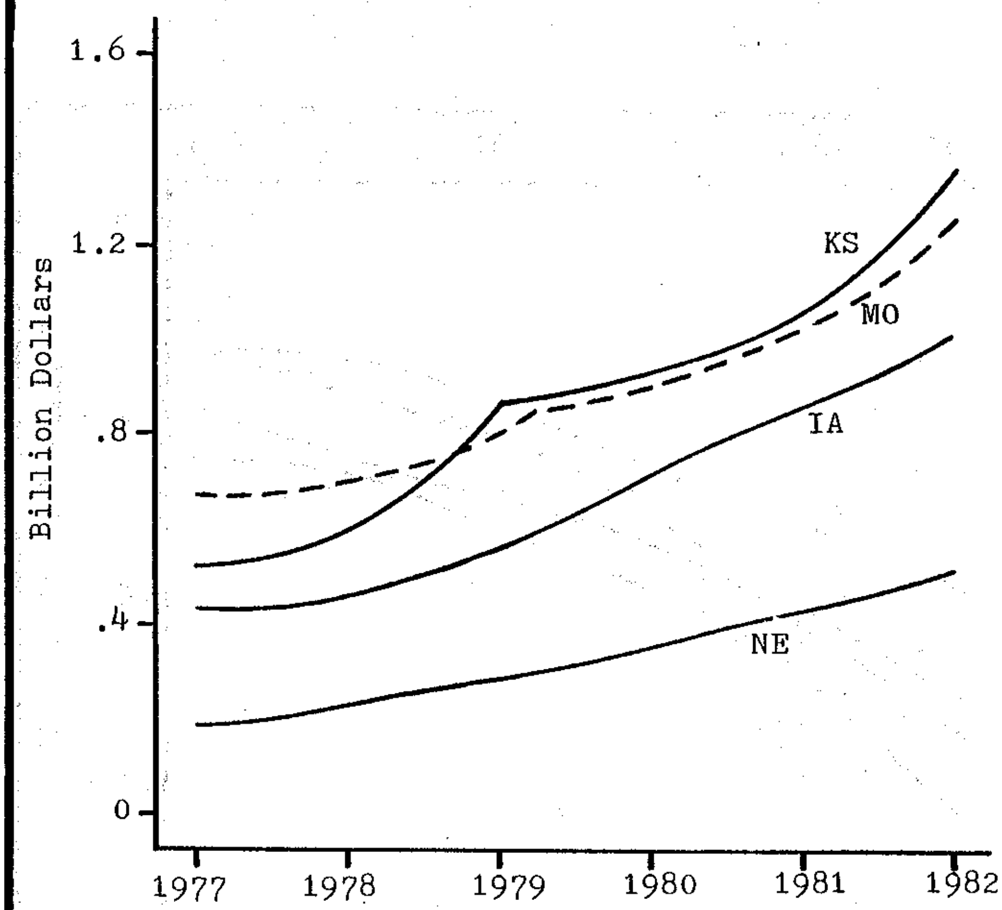
1982 Per Capita Consumption	
U.S.	80
R7	91
IA	84
KS	172
MO	57
NE	89

Million BTU

DWM 10-84

Generally, there has been a decline in total natural gas consumption between 1977 and 1982 in the U.S., the Region as a whole, and all four states within the Region. However, as the illustration points out, particularly in Kansas and Iowa, this declining trend has not been necessarily consistent. Natural gas expenditures, on the other hand, have been increasing rather dramatically over this period. The period rates of change for the states of the Region have been somewhat less than for the nation, but they have been substantial.

NATURAL GAS EXPENDITURES, 1977-1982 (2,3)



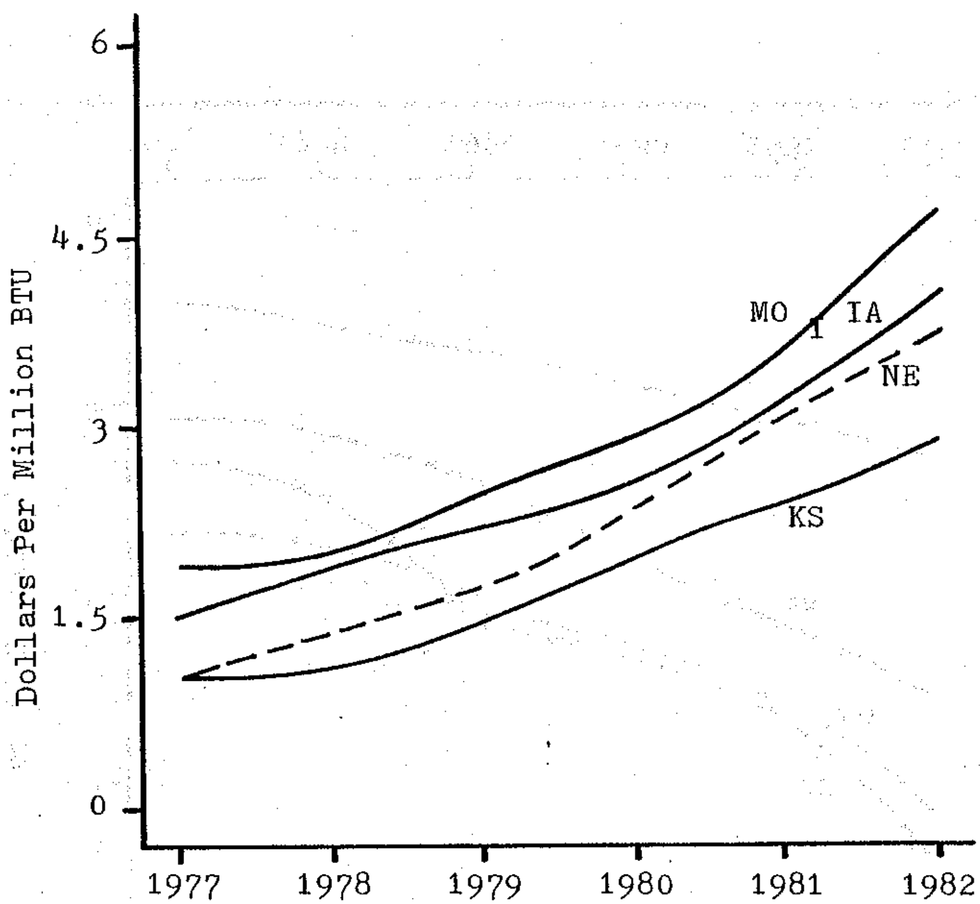
Percent Change 1977-82	
U.S.	133
R7	121
IA	126
KS	125
MO	101
NE	115

1982 Per Capita Expenditures	
U.S.	323
R7	346
IA	346
KS	508
MO	273
NE	334

Million BTU

DWM 10-84

AVERAGE NATURAL GAS RETAIL PRICES, 1977-1982 (2,3)



Percent Change 77-82	
U.S.	151
R7	179
IA	166
KS	182
MO	162
NE	259

Percent Change Per Year	
U.S.	30
R7	36
IA	33
KS	36
MO	32
NE	52

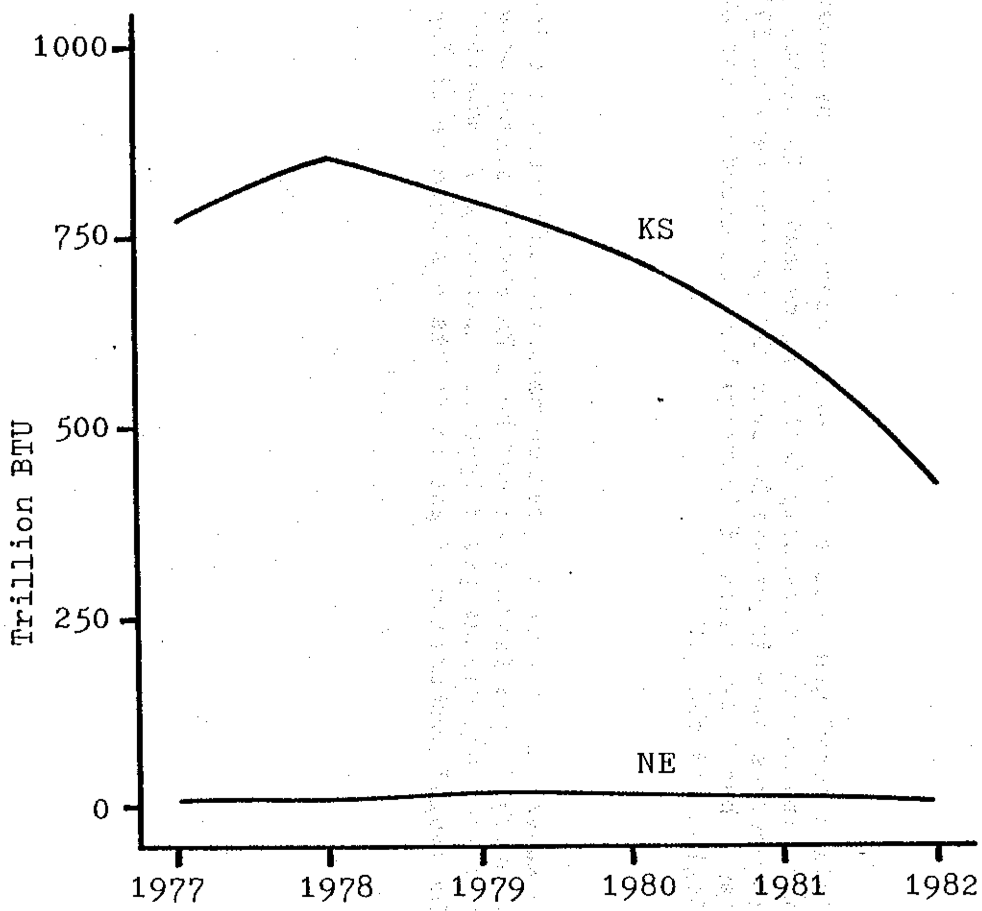
DWM 10-84

Average retail natural gas prices, of course, account for the substantial increases in expenditures with generally declining demand. In Nebraska's case, natural gas prices have increased by over 250 percent between 1977 and 1982. Significant, but lower rates of increase have occurred in the other states of the Region and the U.S.

Production

Two states, Kansas and Nebraska, produce natural gas within the Region. By and large, Nebraska's gas production can best be characterized as very minor. On the other hand, Kansas gas output is substantial. However, in recent years the annual production of gas in Kansas has been declining.

NATURAL GAS PRODUCTION, 1977-1982 (4,5)



Percent Change 1977-82	
U.S.	-8
R7	-45
KS	-45
NE	-33

Per Capita Production 1982	
U.S.	78
R7	36
KS	179
NE	1

Million BTU

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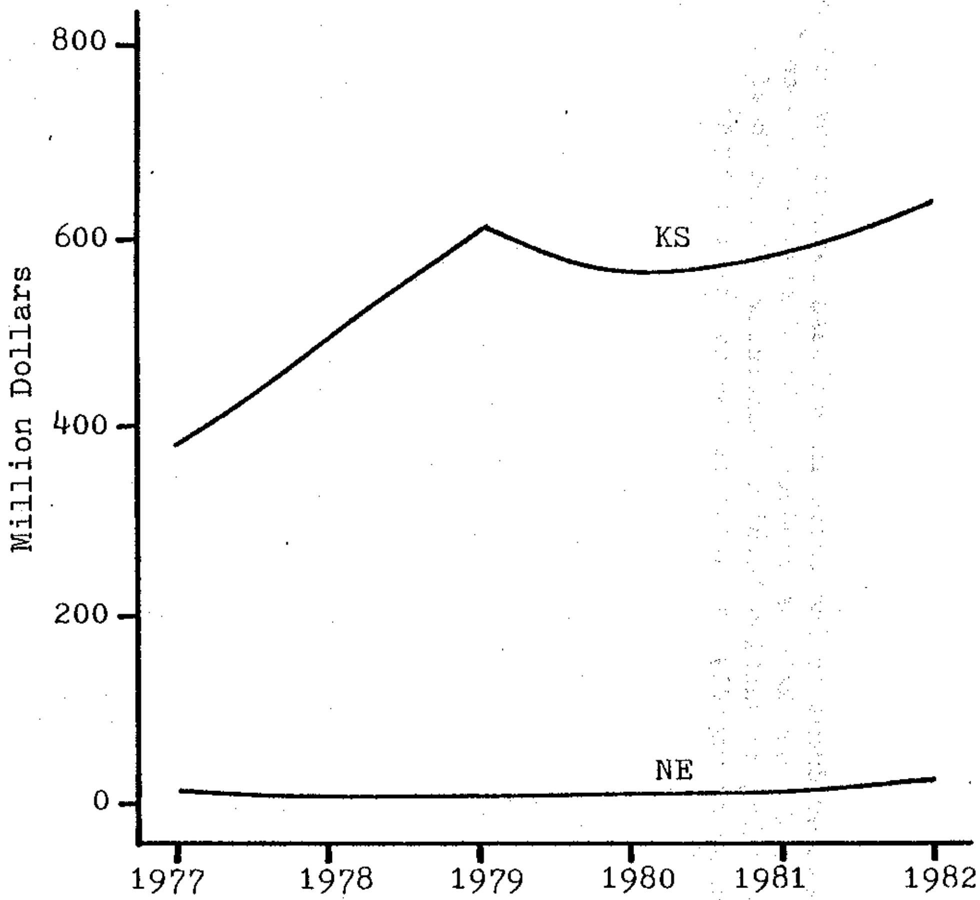
VALUE OF NATURAL GAS PRODUCTION, 1977-1982 (4.5)



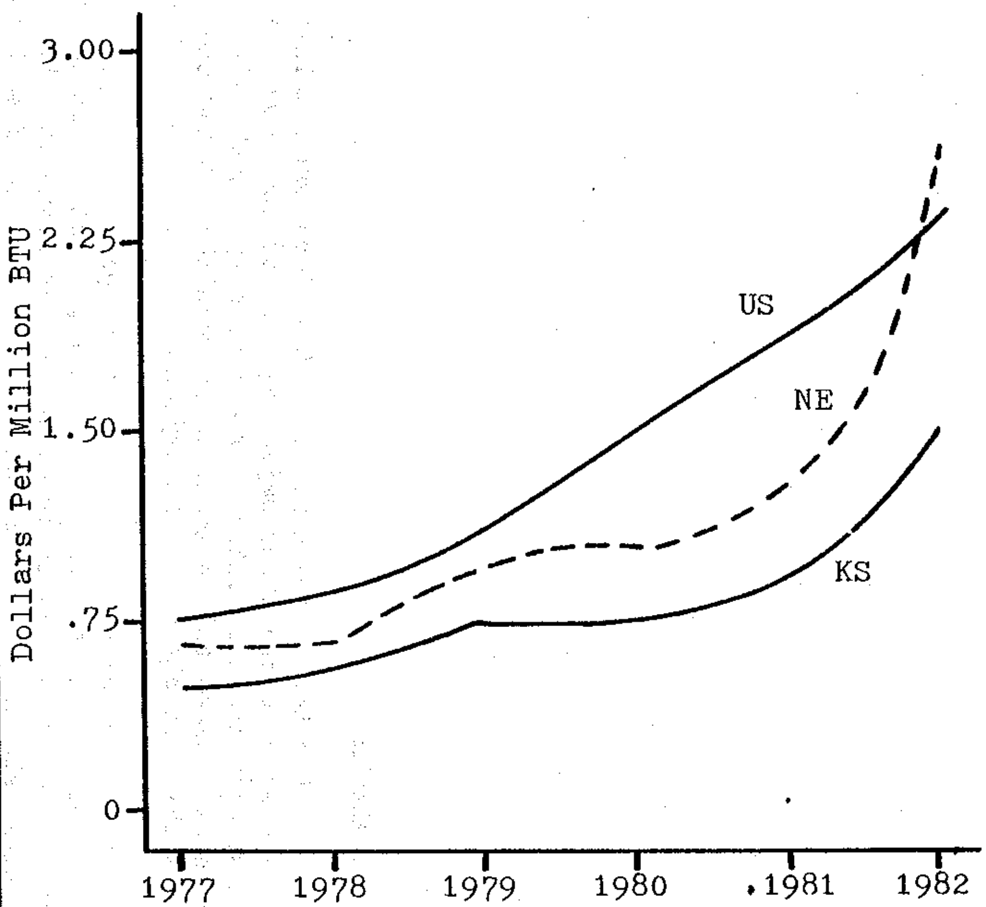
Percent Change 1977-82	
U.S.	185
R7	64
KS	72
NE	150

1982 Per Capita Prod. Value	
U.S.	185
R7	55
KS	270
NE	3
Dollars	

DWM 10-84

Reflecting rather dramatic increases in wellhead natural gas prices, the value of Kansas' and Nebraska's as production has increased between 1977 and 1982 despite declining production levels. Generally, the wellhead prices have not been increasing as rapidly in Kansas as the national average.

WELLHEAD PRICE OF NATURAL GAS, 1977-1982 (4,5)



Percent Change 1977-82	
U.S.	210
R7	196
KS	214
NE	273

Percent Change Per Year	
U.S.	42
R7	39
KS	43
NE	55

DWM 10-84

Production/Consumption Ratio

As has been already noted, Kansas is the Region's only significant producer of natural gas. On the other hand, all four states within the Region consume significant volumes of gas each year. Nationally, the percent of consumption supplied by domestic production has remained relatively stable. By and large, the United States produces most of the natural gas it consumes with the exceptions of small imports from Mexico and Canada. Kansas has over this brief period gone from a major natural gas exporting state to a position in which the state produced in 1982 about as much gas as it consumed.

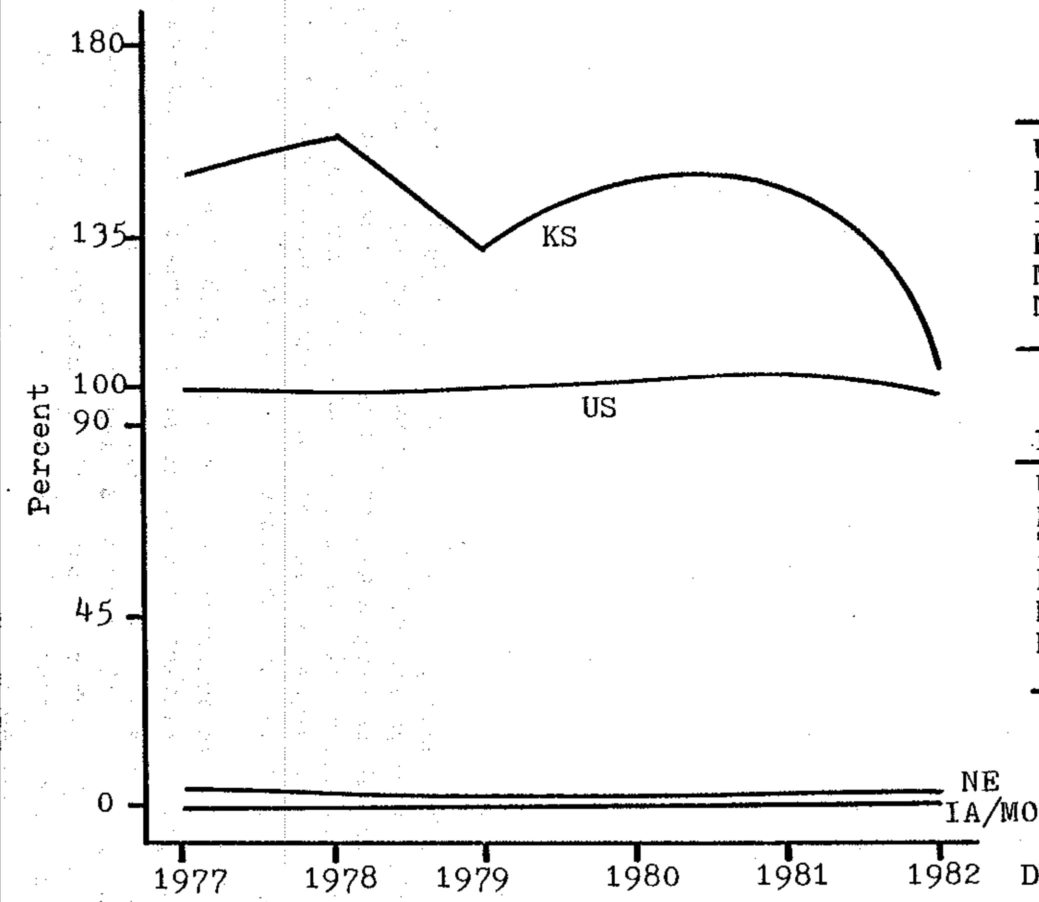
Of the other three states, Nebraska produces only about two percent of its own needs. Both Iowa and Missouri are totally dependent upon imports to meet their gas needs.

Natural Gas Cost Alocations

The illustration on the top of the next page identifies how a dollar spent on natural gas is allocated to the three major segments of this industry -- producers, pipelines, and retail utilities. The data suggests there are significant differences between this allocation between the U.S and the Region, as well as within the states of the Region.

Nationally, about 55 percent of the retail dollar spent on natural gas flows to the accounts of producers. Around 26 cents per dollar constitutes the pipeline companies' share and 19 cents on the dollar represents the retail distribution utilities' share. In the Region about 64 percent of each dollar flows to the producers, 20 percent to the pipelines, and 16 percent to retail utilities.

NATURAL GAS PRODUCTION/CONSUMPTION RATIO, 1977-1982



Percent Change 1977-82	
U.S.	---
R7	-30
IA	---
KS	-31
MO	---
NE	-50

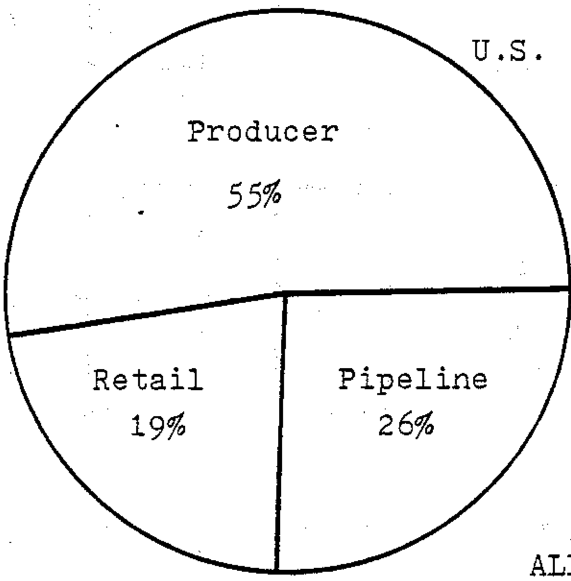
Percent Change Per Year	
U.S.	---
R7	-6
IA	---
KS	-6
MO	---
NE	-10

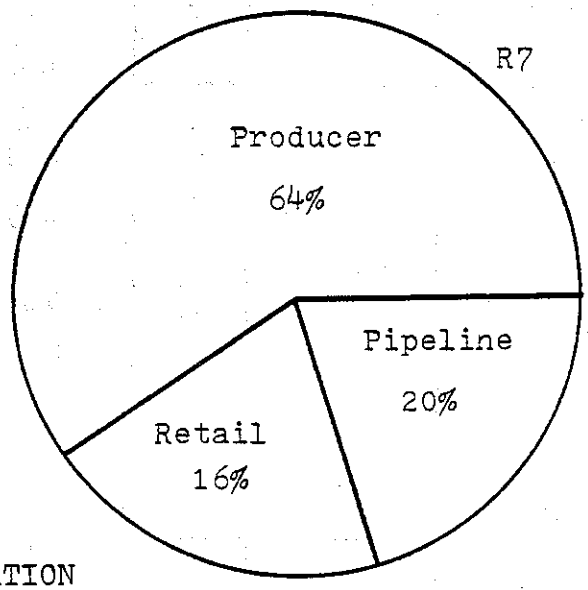
DWM 10-84

In Kansas around 70 cents per dollar was allocated to the producer end of the industry, while the pipeline margin remained relatively the same as in other states, but the retail margin was the lowest in the Region. In Nebraska the data suggests that the portion of the expenditures that represents the producers' margin is even higher at 74 percent. The pipeline margin is 15 percent and the distribution utility share is 11 percent.

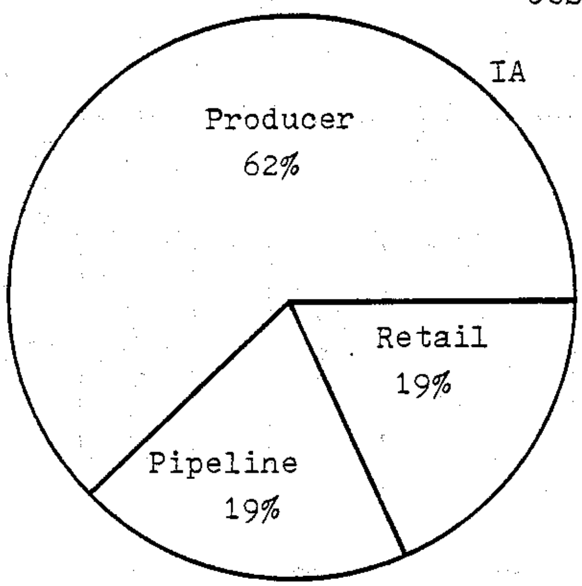
In Missouri, the lowest producer margins exist with about 54 percent allocated to producers reflecting in part Missouri's greater dependence on lower cost gas from Louisiana. Additionally, Missouri has the highest pipeline margin at 21.5 percent, nearly as high as the national average. Finally, Missouri has the highest retail utility margins of any of the four states with 24.5 percent of each dollar spent on gas in Missouri being allocated to retail utilities.

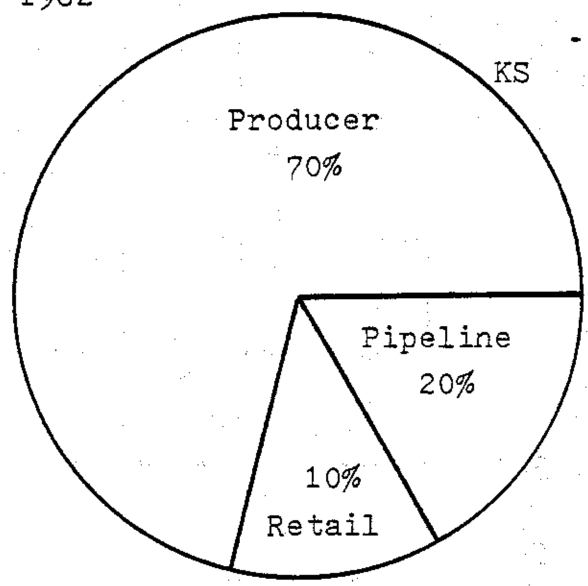
Iowa appears to be the mot representative of the states for the Region. The producers' margin is 62 percent, the pipeline margin is 19 percent, and retail utilities' margin is 19 percent.

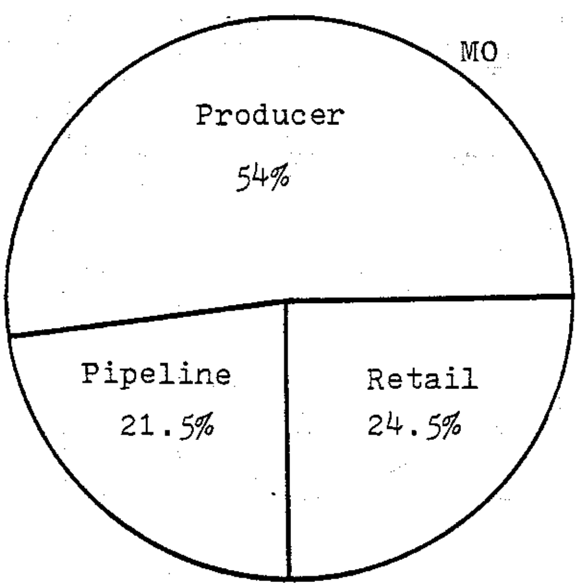


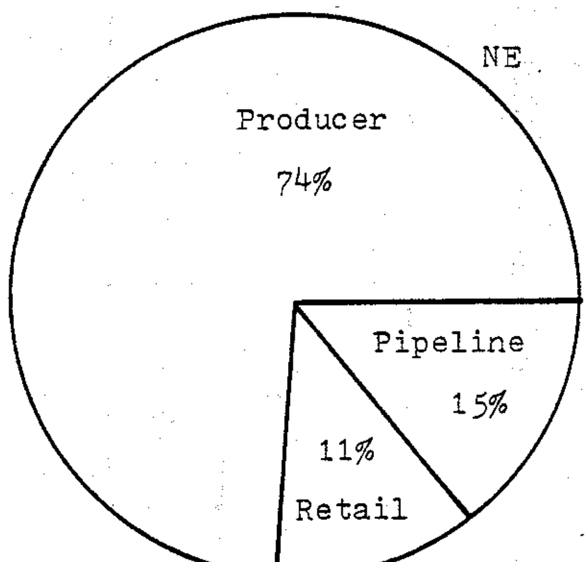


ALLOCATION OF NATURAL GAS COSTS, 1982







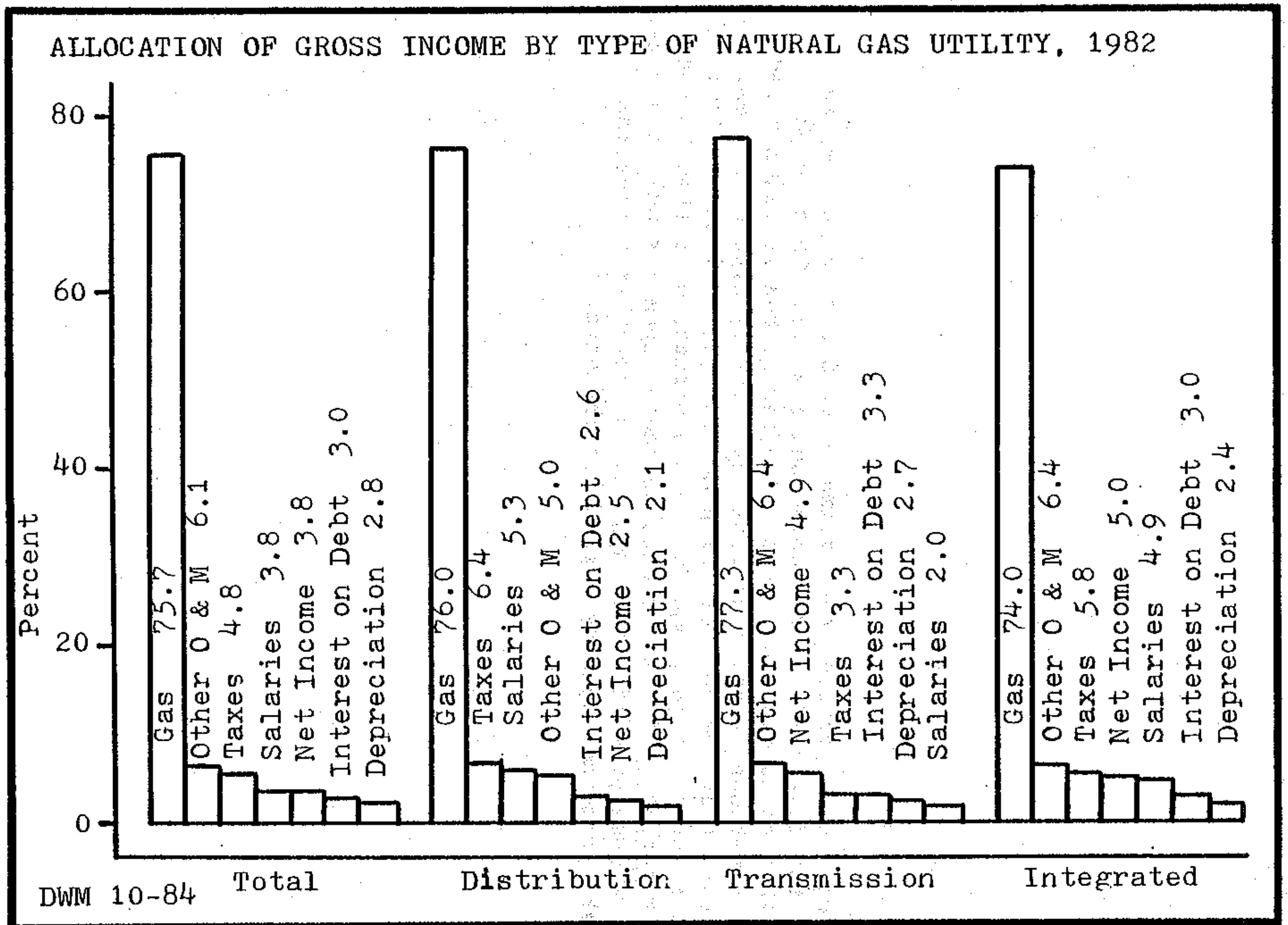


NATURAL GAS PRICE MARGINS, 1982

(in dollars per million BTU)

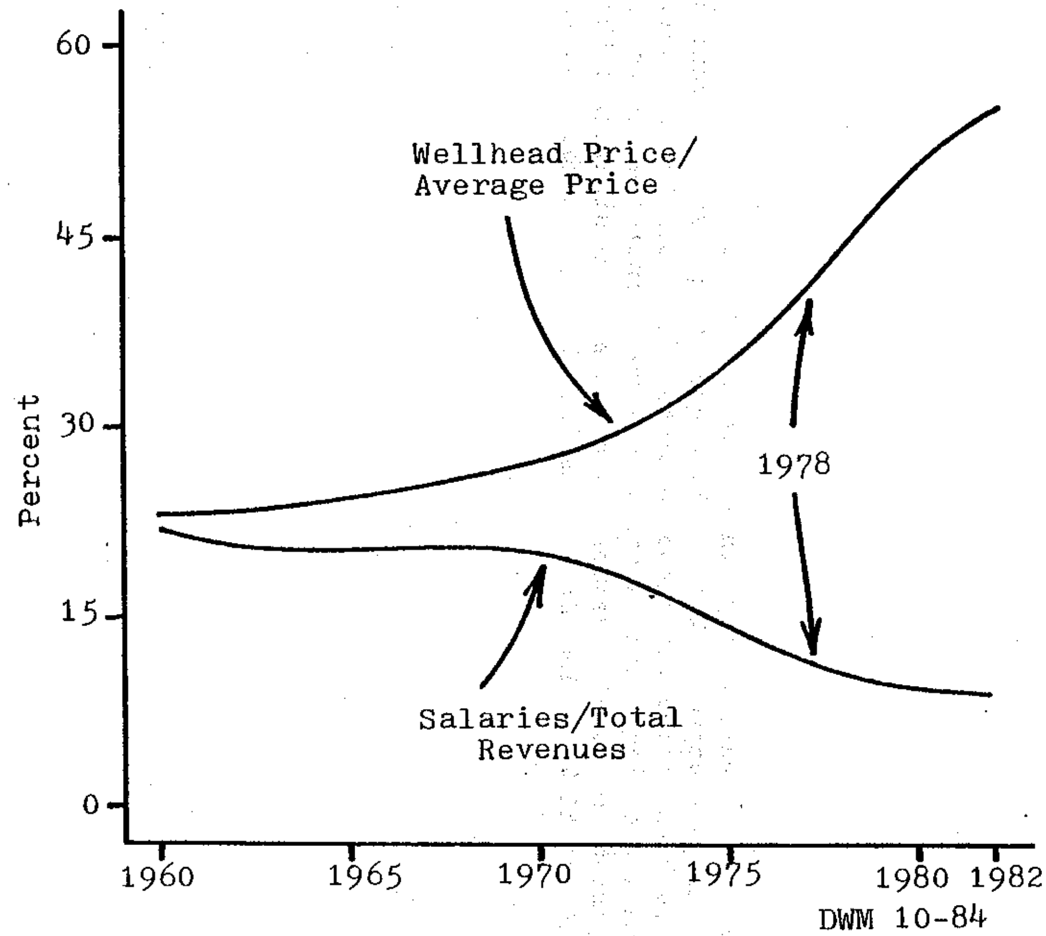
Producer	$2.43	$2.59	$2.59	$2.54	$2.53	$2.81
Pipeline	$3.60	$3.39	$3.38	$3.29	$3.54	$3.38
Average Retail	$4.44	$4.07	$4.18	$3.65	$4.69	$3.78
Residential	$4.97	$4.43	$4.64	$3.99	$5.00	$4.18
Commercial	$4.72	$3.96	$4.28	$3.43	$4.63	$3.66
Industrial	$3.97	$3.69	$3.69	$3.55	$4.02	$3.41

The above illustration provides the estimated producer, pipeline, and retail prices for the four states, the Region and the U.S. This graph highlights one method to account for costs. Another method is illustrated below that displays national average natural gas costs by type of system. It is generally believed that the cost of doing natural gas business in Iowa is about the same as in other states, but due to the structure created by the Natural Gas Policy Act of 1978, each state, depending upon its unique sources of supply, may have somewhat different input gas prices that affect the allocation of costs from one industry segment to the next.



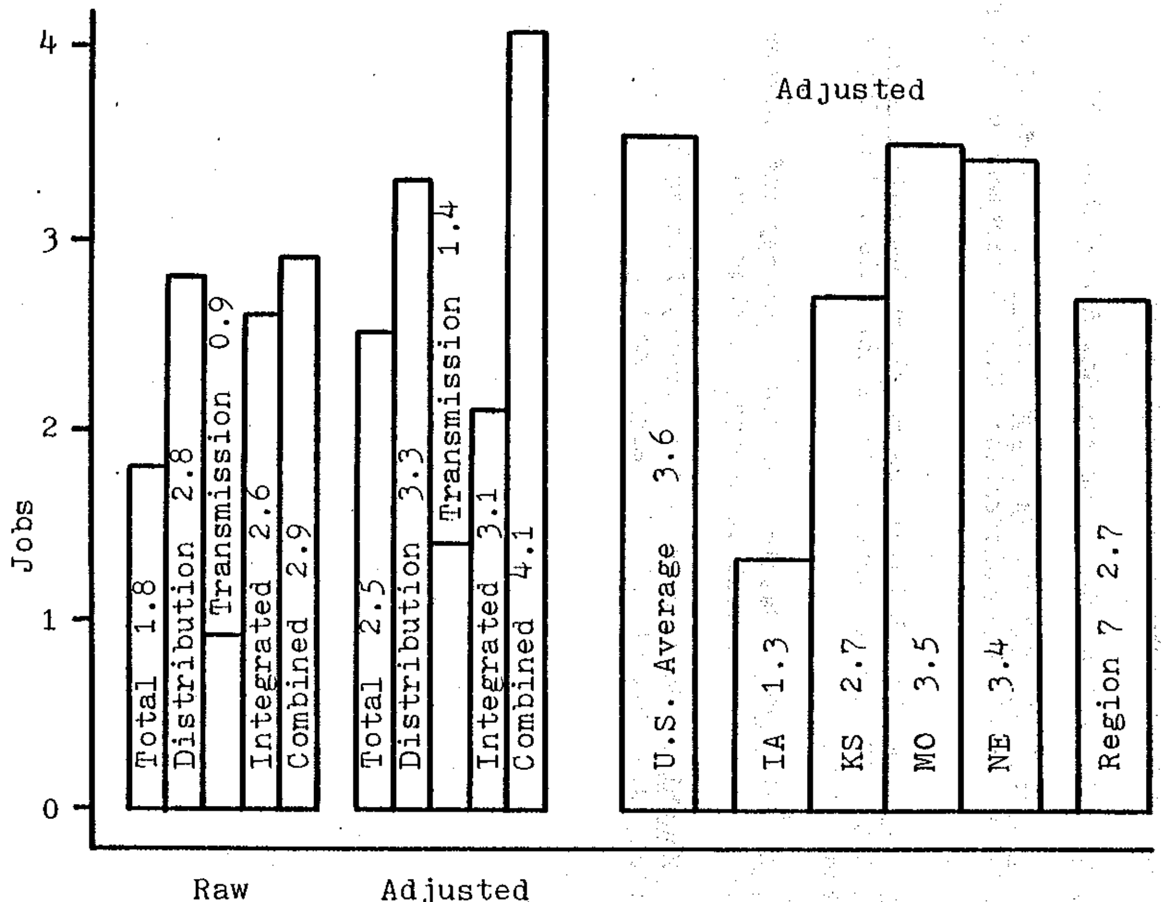
ALLOCATION OF GROSS INCOME BY TYPE OF NATURAL GAS UTILITY, 1982
Percent
80
60
40
20
0
Gas 75.7
Other O & M 6.1
Taxes 4.8
Salaries 3.8
Net Income 3.8
Interest on Debt 3.0
Depreciation 2.8
Gas 76.0
Taxes 6.4
Salaries 5.3
Other O & M 5.0
Interest on Debt 2.6
Net Income 2.5
Depreciation 2.1
Gas 77.3
Other O & M 6.4
Net Income 4.9
Taxes 3.3
Interest on Debt 3.3
Depreciation 2.7
Salaries 2.0
Gas 74.0
Other O & M 6.4
Taxes 5.8
Net Income 5.0
Salaries 4.9
Interest on Debt 3.0
Depreciation 2.4
Total
Distribution
Transmission
Integrated
DWM 10-84

RELATIVE IMPORTANCE OF PURCHASED NATURAL GAS COMPARED WITH SALARIES IN THE U.S. NATURAL GAS INDUSTRY, 1960-1982



There has been a fundamental change in the natural gas industry, particularly over the past decade. The wellhead cost of gas as a percent of the retail price has been increasing rather dramatically. Conversely, this industry has become increasingly less labor intensive as indicated by the drop in salaries as a percent of total revenues. The table below highlights the on-going employment creation of the natural gas industry by category and state.

NATURAL GAS UTILITY JOBS SUPPORTED BY $1 MILLION OF NATURAL GAS REVENUES, 1982



Adjusted values have been equalized so that all salaries equal $20,000 per job. Consequently a job created in KS equals the same value as a job in MO.

DWM 10-84

END NOTES TO THE PETROLEUM ANALYSIS SECTION

(1) State Energy Price and Expenditure Report 1970-1981. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, June 1984.

(2) State Energy Price Report, 1970-1982. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, August 1984.

(3) State Energy Data Report. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, May 1984.

(4) Monthly Energy Review. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, monthly.

(5) 1982 Gas Facts. Arlington, VA: American Gas Association, 1983.

(6) Statistics of Interstate Natural Gas Companies, 1982. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, October 1983.

(7) Gas Supplies of Interstate Natural Gas Pipeline Companies, 1982. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, October 1983.

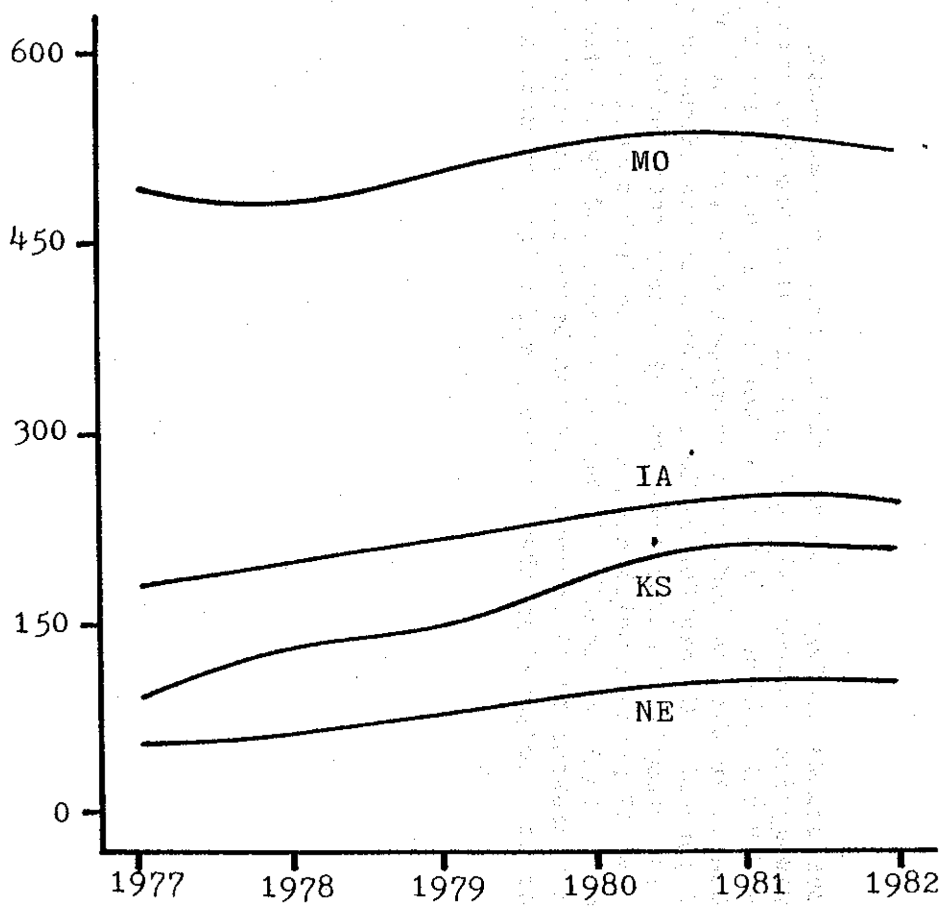
(8) Natural Gas Annual, 1982. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, October 1983.

(9) Natural Gas Monthly. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, monthly.

4.4 COAL ANALYSIS

All four states of Region Seven utilize coal to meet energy needs. Growth in coal consumption between 1977 and 1982 has been somewhat greater than experienced by the nation as a whole. While coal consumption of the U.S. grew by 10 percent over this period, coal consumption in the states of Region Seven grew by 29 percent. Within the Region, changes in coal consumption were unequal. For example, between 1977 and 1982, coal consumption in Kansas increased by 137 percent while coal consumption in Missouri increased by only four percent. Coal consumption in Nebraska increased by 63 percent and Iowa coal usage increased by 34 percent. As the below illustration highlights, the majority of coal consumed in these states is for the production of electricity.

COAL CONSUMPTION, 1977-1982 (1)



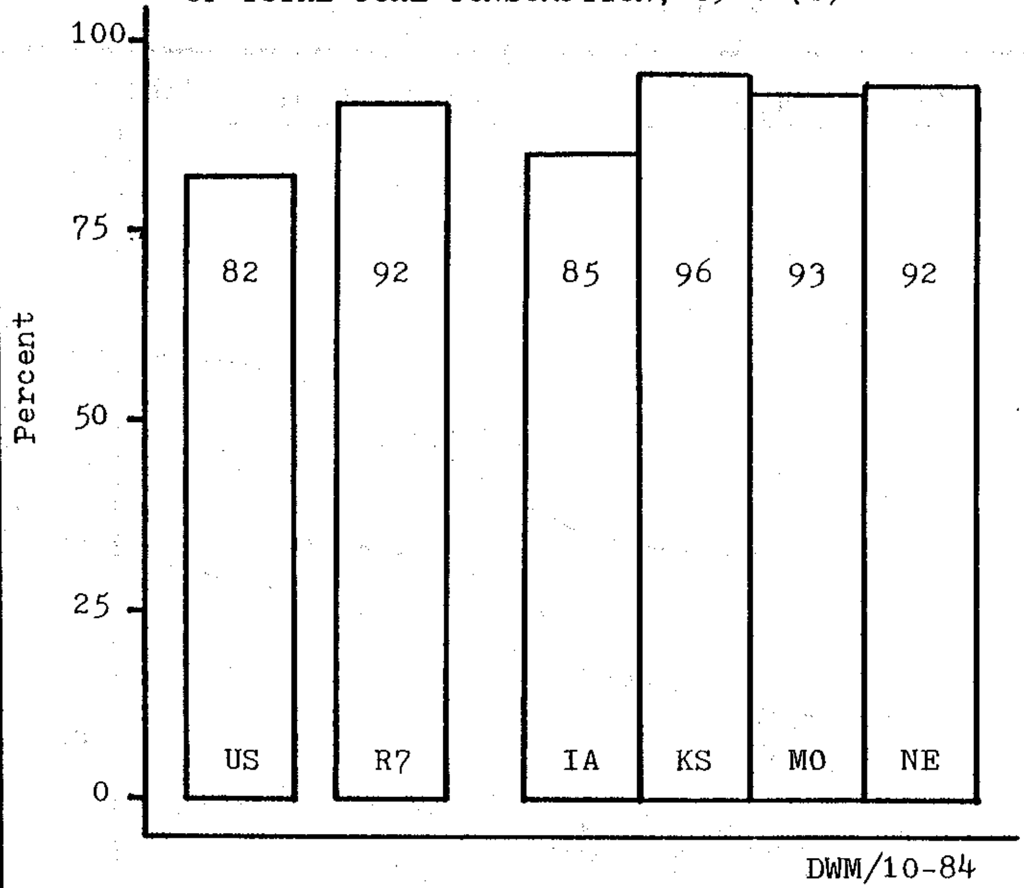
Percent Change 1977 to 1982	
US	10%
R7	29
IA	34
KS	137
MO	4
NE	63

Per Capita, 1982 Coal Consumption	
US	66
R7	91
IA	85
KS	89
MO	105
NE	60

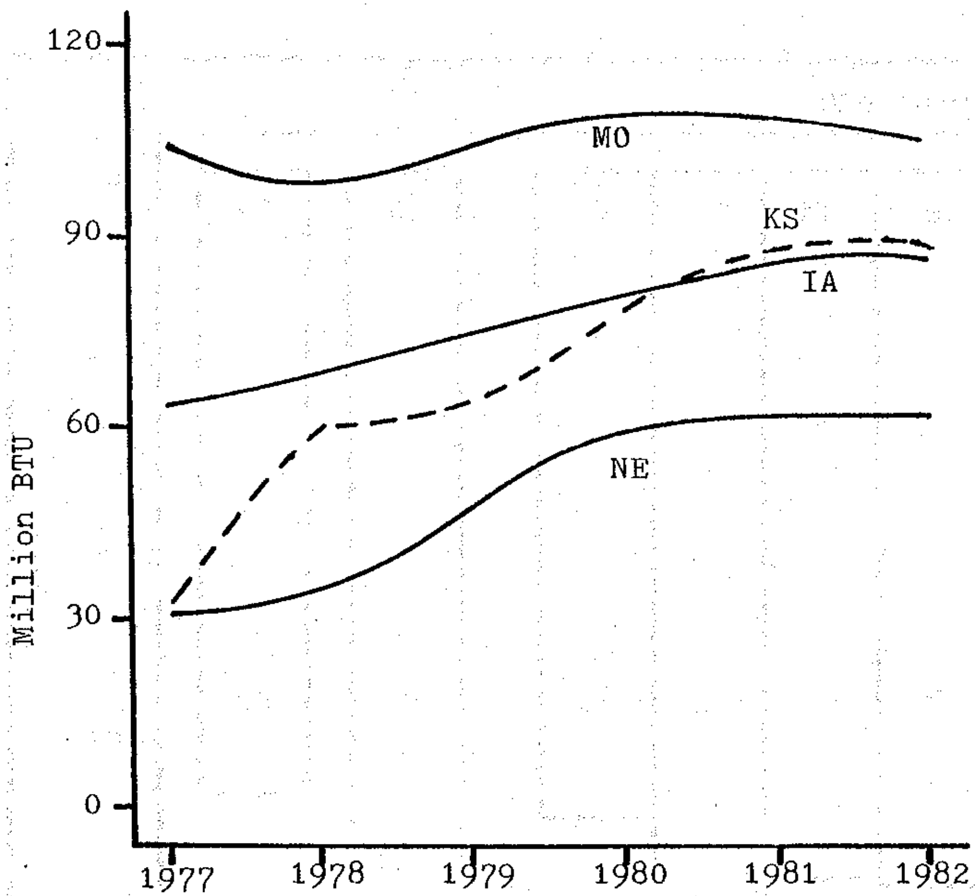
Million BTU

DWM/10-84

COAL CONSUMED BY ELECTRIC UTILITIES AS A PERCENT OF TOTAL COAL CONSUMPTION, 1982 (1)



PER CAPITA COAL CONSUMPTION, 1977-1982 (1,4)



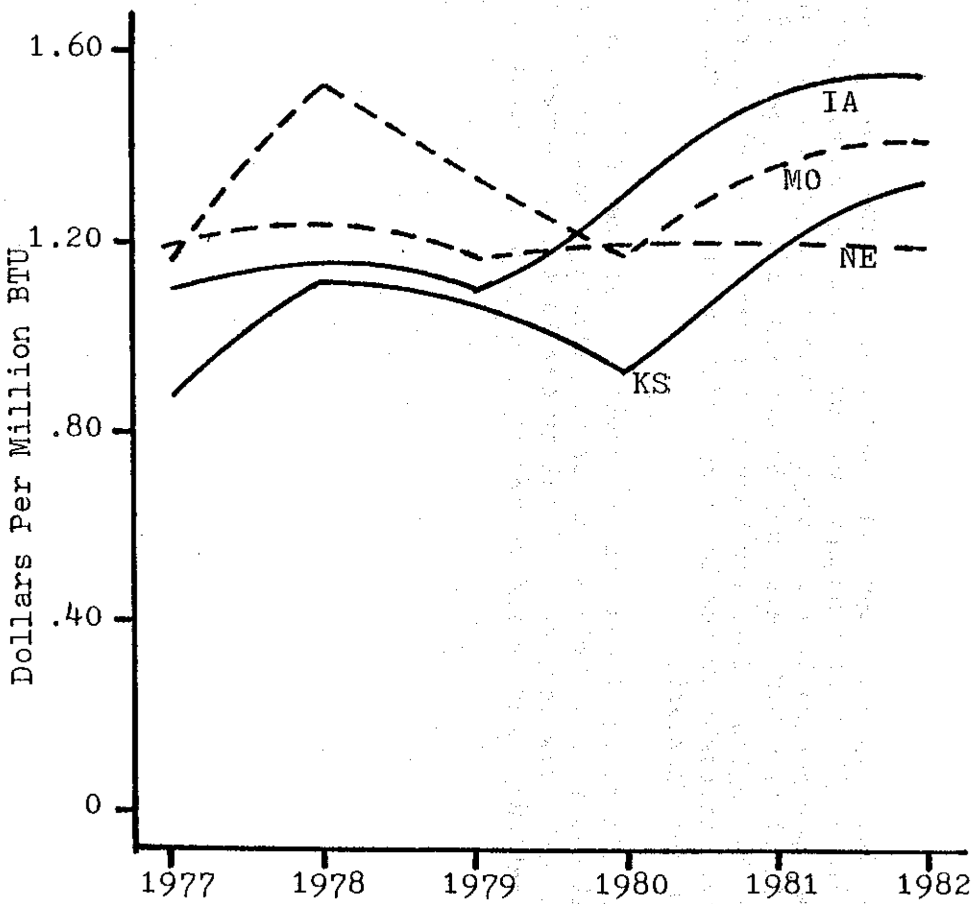
Percent Change 1977 to 1982	
US	5%
R7	47
IA	35
KA	128
MO	0
NE	62

DWM/10-84

Region Seven is more dependent upon coal than the rest of the country in terms of per capita coal consumption. While the nation consumed 66 million BTU of coal per person in 1982, Region Seven had a per capita coal consumption level of 91 million BTU. Missouri is the most coal dependent of the four states in the Region. Iowa and Kansas have similar levels of coal dependency. Nebraska is the least dependent upon coal (60 versus 105 million BTU/person for Missouri).

The retail price of coal has fluctuated over the 1977 to 1982 period. On a Regional basis, coal prices over these years have not increased as rapidly as nationally. However, retail coal prices in Kansas increased more rapidly than the national average and prices in Iowa increased nearly as rapidly.

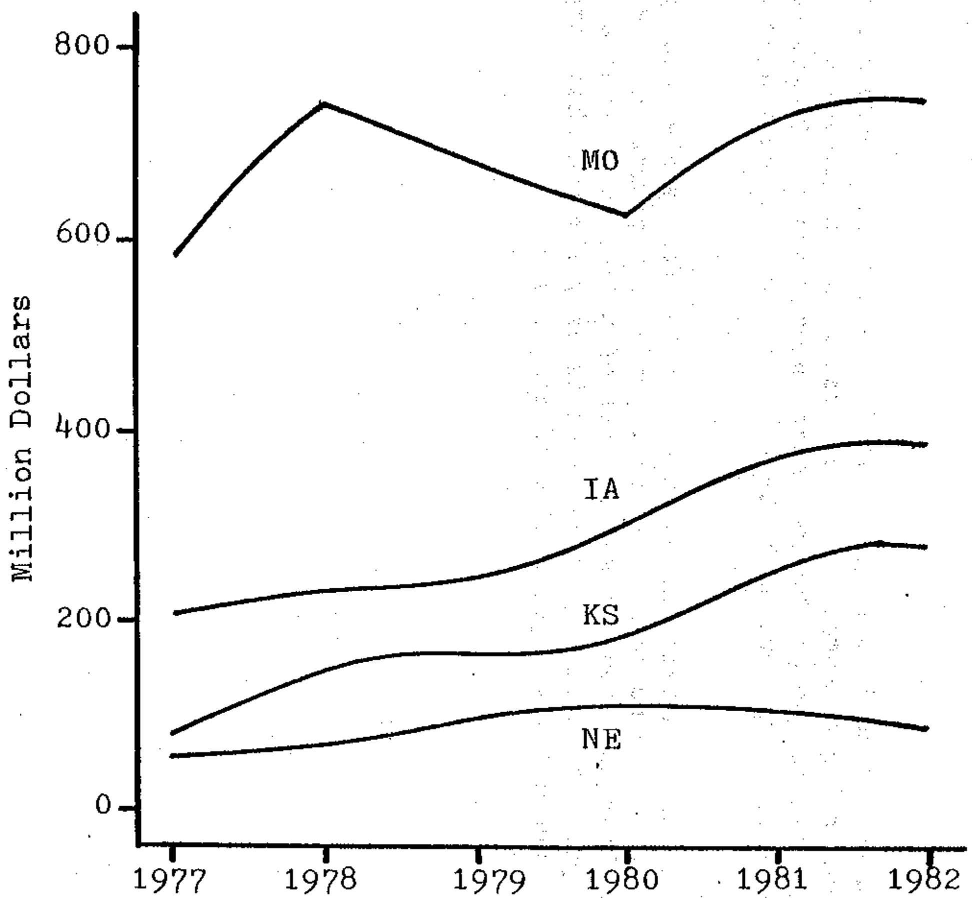
AVERAGE RETAIL COAL PRICE, 1977-1982 (2,3)



Percent Change 1977 to 1982	
US	43%
R7	27
IA	41
KS	52
MO	23
NE	0

DWM/10-84

EXPENDITURES FOR COAL, 1977-1982 (2,3)



Percent Change 1977 to 1982	
US	58%
R7	64
IA	89
KS	262
MO	28
NE	62

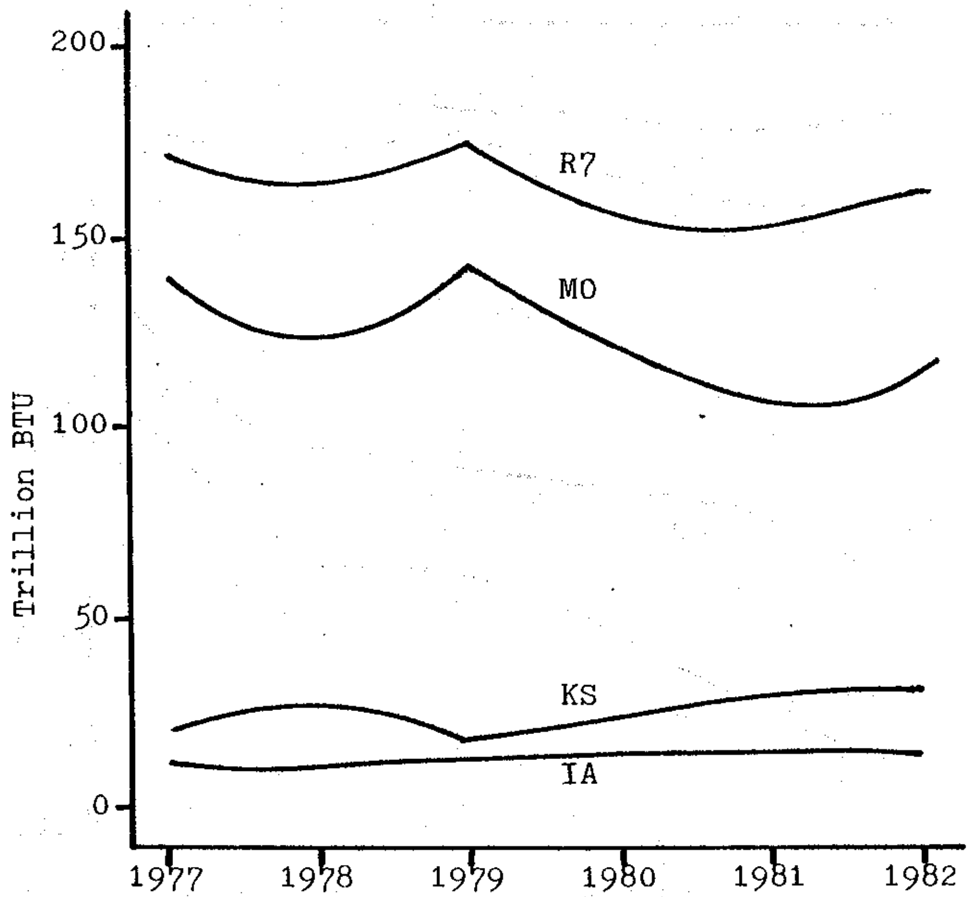
Per Capita, 1982 Expenditures	
US	$108
R7	129
IA	134
KS	119
MO	150
NE	70

DWM/10-84

Expenditures for coal have increased due to moderate increases in the volumes of coal being consumed and modest retail price increases. It should be noted that coal as one of the four major energy sources (petroleum, natural gas, and electricity) has proven to be the least inflationary over the 1977 to 1982 period.

As the illustration below notes, three of the four states produce coal. Nebraska currently has no commercial coal production operations. However, Nebraska does have coal resources which are of a limited current economic value. Coal production in Kansas and Iowa is very limited when compared with Missouri and particularly major coal producing states.

COAL PRODUCTION, 1977-1982 (5)

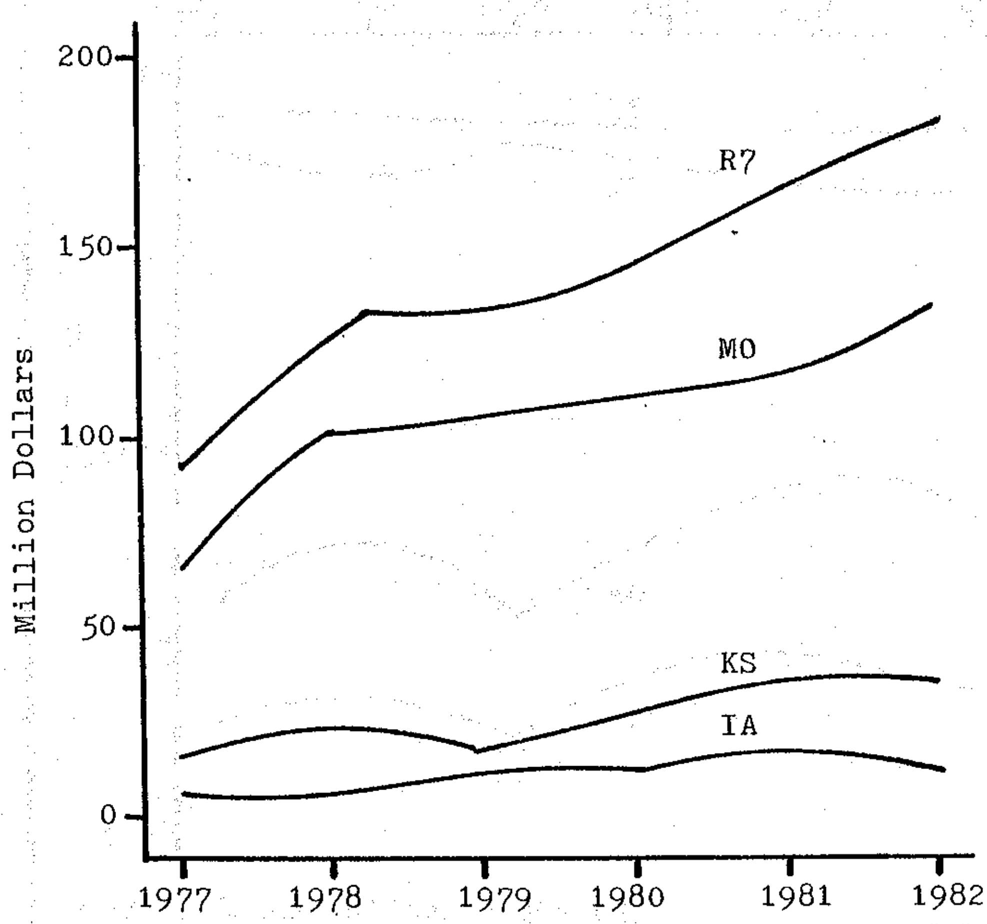


Percent Change 1977 to 1982	
R7	-6%
IA	18
KS	55
MO	-16

Per Capita, 1982 Production	
R7	14
IA	4
KS	13
MO	24
	10^6BTU

DWM/10-84

VALUE OF COAL PRODUCTION, 1977-1982 (5)



Percent Change 1977 to 1982	
R7	107%
IA	71
KS	118
MO	108

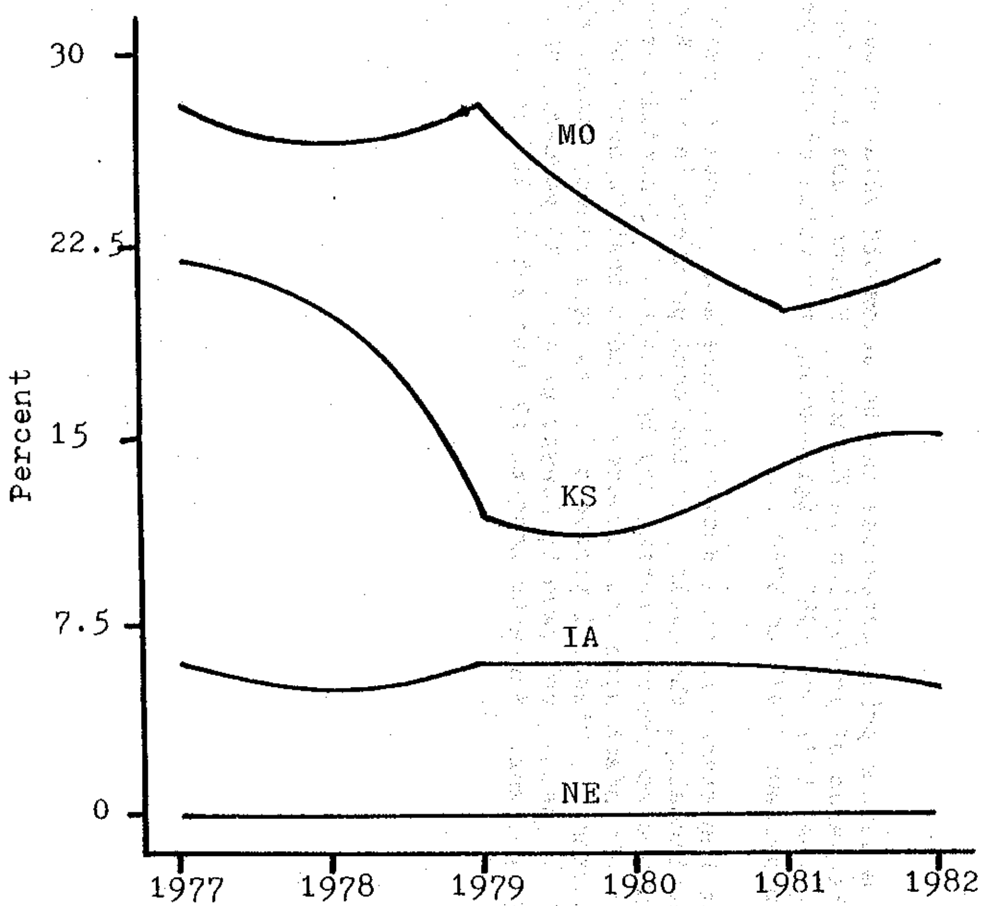
Per Capita, 1982 Production Value	
R7	$16
IA	4
KS	15
MO	27

DWM/10-84

Due to moderate price increases in the minemouth value of coal, the value of coal, the value of production in Missouri, Kansas, and Iowa has increased somewhat between 1977 and 1982. Region-wide, the value of coal production is up over 100 percent (1977 to 1982).

None of the states in this Region produce enough coal to meet their own needs. Additionally, the quality of the coal produced in this Region is such that its future economic potential may be limited. Generally, the Region has become more dependent upon coal imports to meet instate needs over this period. Currently, Missouri produces (on an equivalency basis) about 25 percent of its needs, followed by Kansas at about 15 percent, and Iowa at under seven percent. Nebraska imports 100 percent of its coal.

COAL PRODUCTION/CONSUMPTION RATIO, 1977-1982 (1,5)



Percent Change 1977 to 1982	
R7	-48%
IA	-16
KS	-32
MO	-21

DWM/10-84

Table 4-2 Coal Import Analysis

1982	IA	KS	MO	NE	R7
Consumption[a]	247	213	525	906	1,081
Expenditures[b]	388	286	751	112	1,537
Production[a]	13	31	118	---	162
Product Value[b]	12	37	137	--	186
Imports					
BTU[a]	234	182	407	96	919
Cost[b]	376	249	614	112	1,351
% Imports					
BTU	95	85	78	100	85
Cost	97	87	82	100	88

a) trillion BTU
b) million dollars

Nebraska depends totally on coal imports to meet its needs. Consequently, 100 percent of its coal expenditures are treated as leakages from the state.

Using an equivalency method (where instate production is assumed to be consumed instate and thereby displaces imports), the other three states reduce their import leakages due to instate production. It is useful to compare the value of instate production against the price of purchased coal.

Table 4-3 **Production Versus Retail Price Comparison**

1982	IA	KS	MO	R7
Production Price[a]	.92	1.19	1.16	1.15
Retail Price[a]	1.57	1.34	1.43	1.42
Margin[a]	.65	.15	.27	.27
Margin/Retail P.[b]	41	11	19	19

a) dollars per million BTU.
b) percent

Leakages would be determined by treating the wellhead value of net imports (consumption - production) as a 100 percent leakage. The wellhead value of instate production would be treated as instate expenditure in the first transaction round. The margin on the coal consumed supplied by instate production would be treated as an instate expenditure during the first round. Generally, an assumption is made about the remaining margin value as its leakage level

END NOTES TO THE PETROLEUM ANALYSIS SECTION

(1) State Energy Price and Expenditure Report 1970-1981. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, June 1984.

(2) State Energy Price Report, 1970-1982. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, August 1984.

(3) State Energy Data Report. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, May 1984.

(4) Monthly Energy Review. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, monthly.

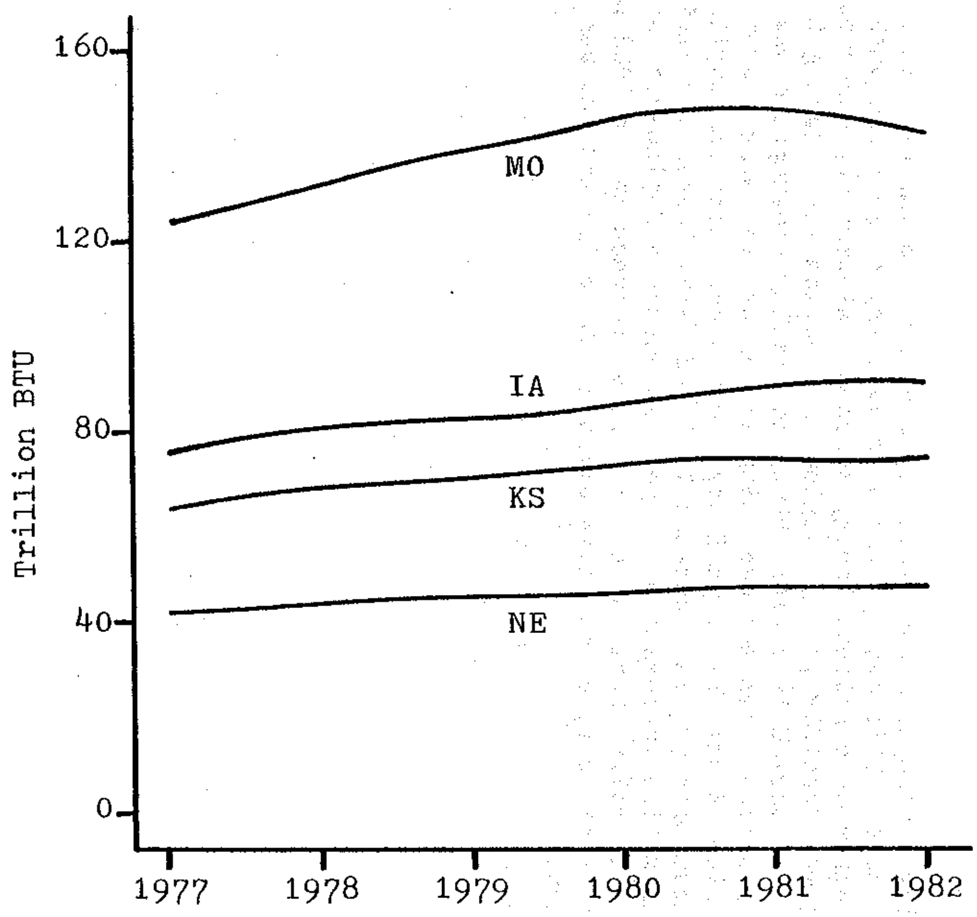
(5) Caol Production. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, annual.

(6) Energy Information Administration, U.S. Department of Energy, 1984.

4.5 ELECTRICITY ANALYSIS

Electricity consumption has generally continued to increase in absolute and per capita terms. This overall trend is contrary to what has been occurring with other conventional energy sources. Electricity consumption has been increasing more rapidly in this Region than nationally. During the latter part of this period it appears that electricity consumption has been stabilizing in absolute terms and declining in per capita terms. Over this 1977 to 1982 period, Kansas has experienced very significant per capita electricity consumption growth. Between 1977 and 1982, Kansas per capita electricity consumption increased by 36 percent versus a Region-wide average of 11 percent. Generally there is very little difference in the 1982 per capita level of electricity consumption between the nation and the Region and within the Region.

ELECTRICITY CONSUMPTION, 1977-1982 (1)



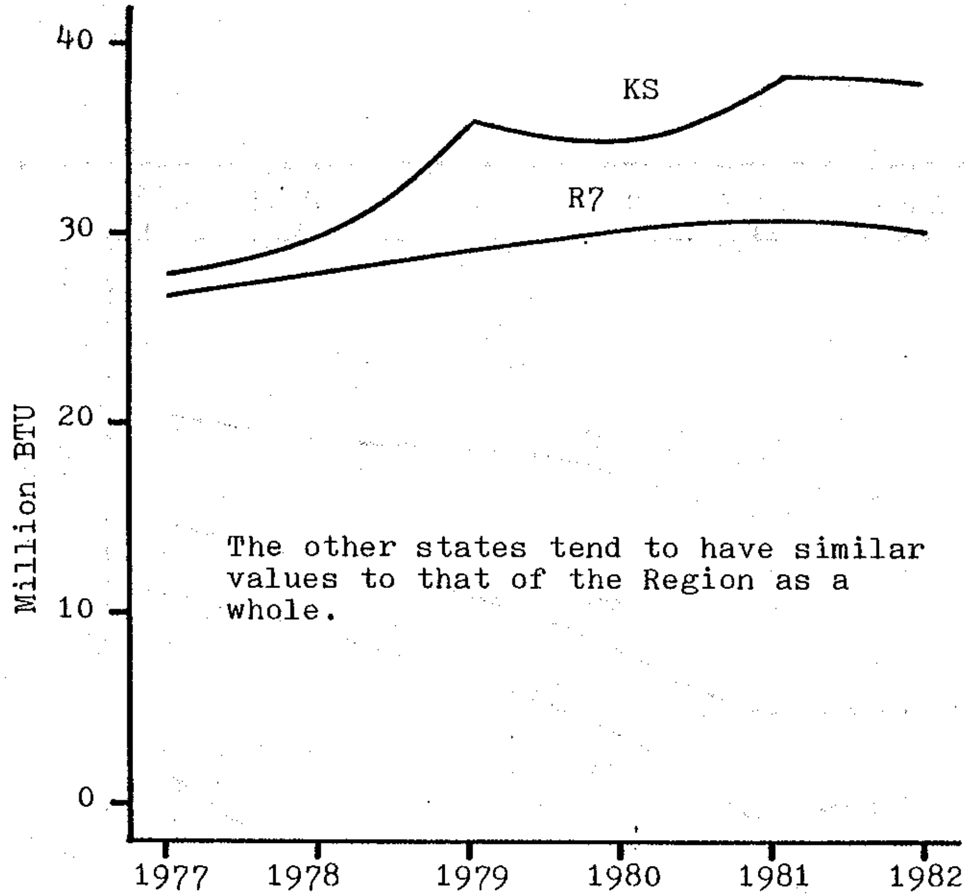
Percent Change 1977 to 1982	
US	7
R7	15
IA	17
KS	15
MO	14
NE	14

1982 Per Capita Consumption	
US	31
R7	30
IA	31
KS	31
MO	29
NE	30

Million BTU

DWM 10-84

PER CAPITA ELECTRICITY CONSUMPTION, 1977-1982 (1,4)

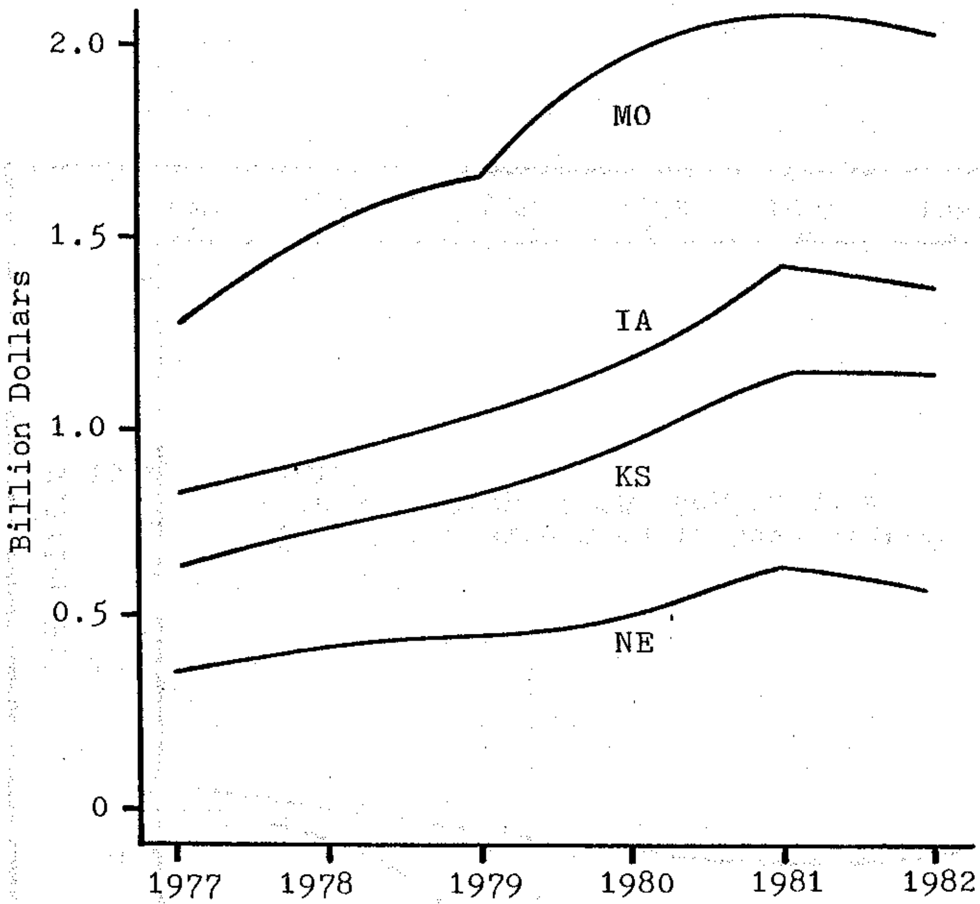


The other states tend to have similar values to that of the Region as a whole.

Percent Change 1977-1982	
U.S.	3
R7	11
IA	11
KS	36
MO	12
NE	15

DWM 10-84

ELECTRICITY EXPENDITURES, 1977-1982 (1,2,3)



Percent Change 1977 to 1982	
US	91
R7	65
IA	68
KS	79
MO	58
NE	59

1982 Per Capita Expenditures	
US	522
R7	435
IA	479
KS	486
MO	408
NE	364

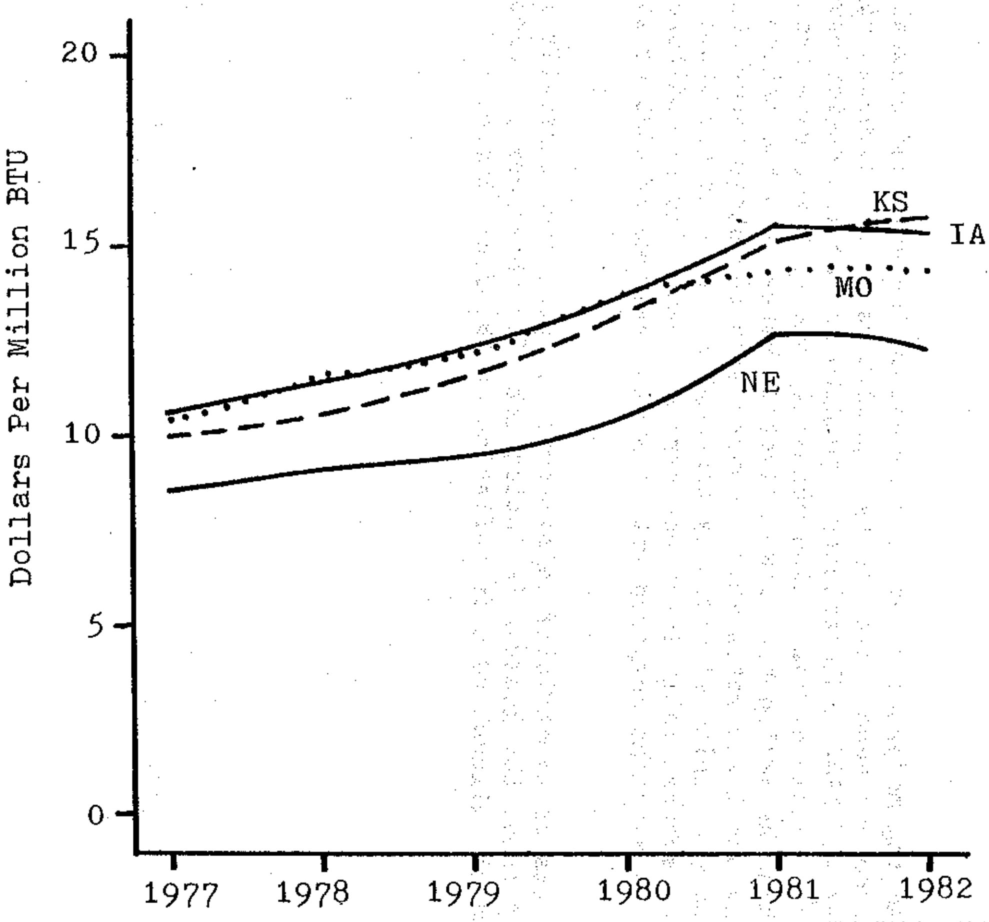
Dollars

DWM 10-84

Reflecting moderate rates of consumption increase and general inflation-rates of price increase, electricity expenditures have increased significantly between 1977 and 1982. Electricity expenditures for the Region have not increased as rapidly as the nation primarily due to lower rate increases. The states within the Region have lower electric rates than the nation. Nebraska particularly has lower rates when compared with the other three states. With very similar per capita electricity consumption rates as the other states, Nebraska has substantially lower per capita electricity expenditures -- $364 per person in Nebraska compared with a Region average of $435 or 16 percent lower.

In terms of electricity retail prices, rates have generally increased at or slightly above the general inflation rate for this period. Kansas has experienced the highest rate of inflation of the four states.

ELECTRICITY RETAIL PRICES, 1977-1982 (2,3)



Percent Change 1977 to 1982	
US	79
R7	43
IA	44
KS	55
MO	38
NE	39

Percent Change Per Year, 77-82	
US	16
R7	9
IA	9
KS	11
MO	8
NE	8

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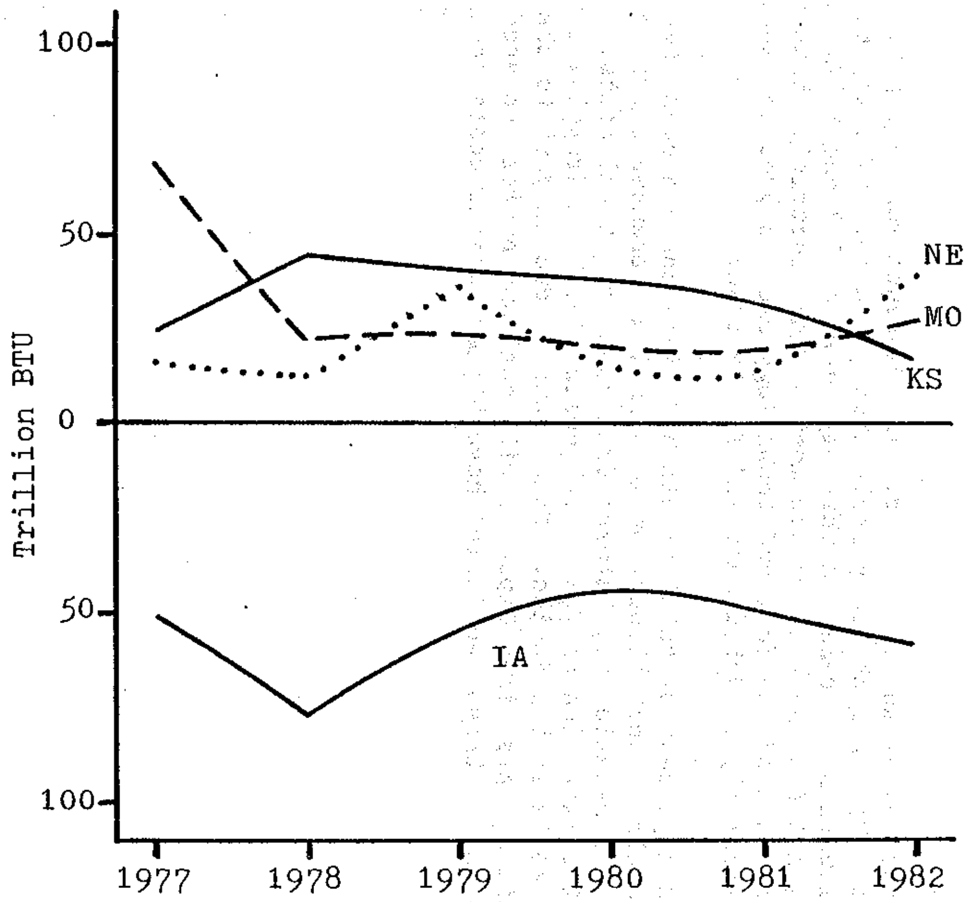
NET ELECTRICITY INTERSTATE EXCHANGES, 1977-1982 (1)



Percent Change 1977 to 1982	
IA	18
KS	-31
MO	-61
NE	117

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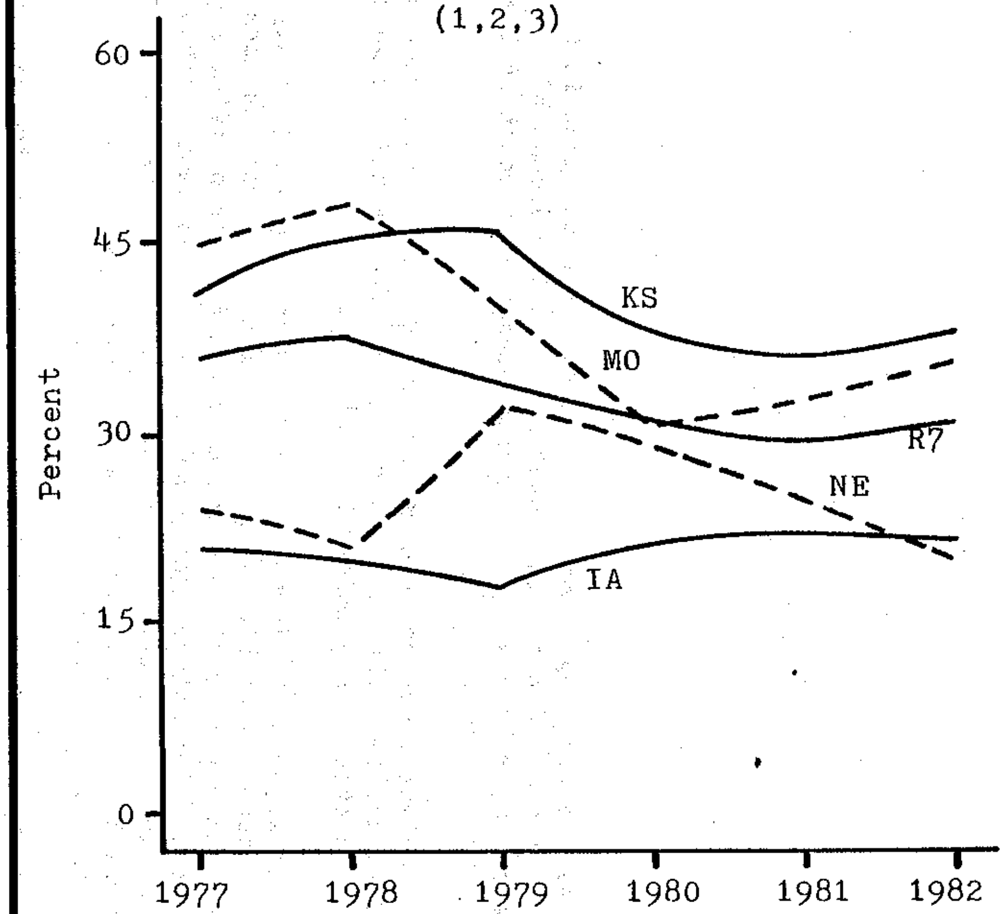
Three of the states --Kansas, Missouri, and Nebraska were net power exporters in 1982. Iowa was the only state that was a net power importer. Generally this situation has remained this way between 1977 and 1982. Despite Iowa's situation, all four states produce most of the electricity that they consume. However, much of the fuel and technology used to produce electricity is imported, particularly in Nebraska's and Iowa's cases.

Fuel costs as a percent of total viable and fixed costs account for about 30 cents on the dollar. Cost allocation information presented later in this section details this relationship between fuel costs and total costs. Generally, with the exception of Iowa, fuel costs have been dropping as a percent of total costs in the Region. This trend is due in part to the replacement of oil and gas fired capacity with coal and nuclear powered facilities. Generally, these facilities have higher capital costs, but lower fuel costs.

FUEL COSTS AS A PERCENT OF ELECTRICITY EXPENDITURES, 1977-1982
(1,2,3)



Percent Change 1977 to 1982	
R7	-14
IA	4
KS	-7
MO	-20
NE	-26

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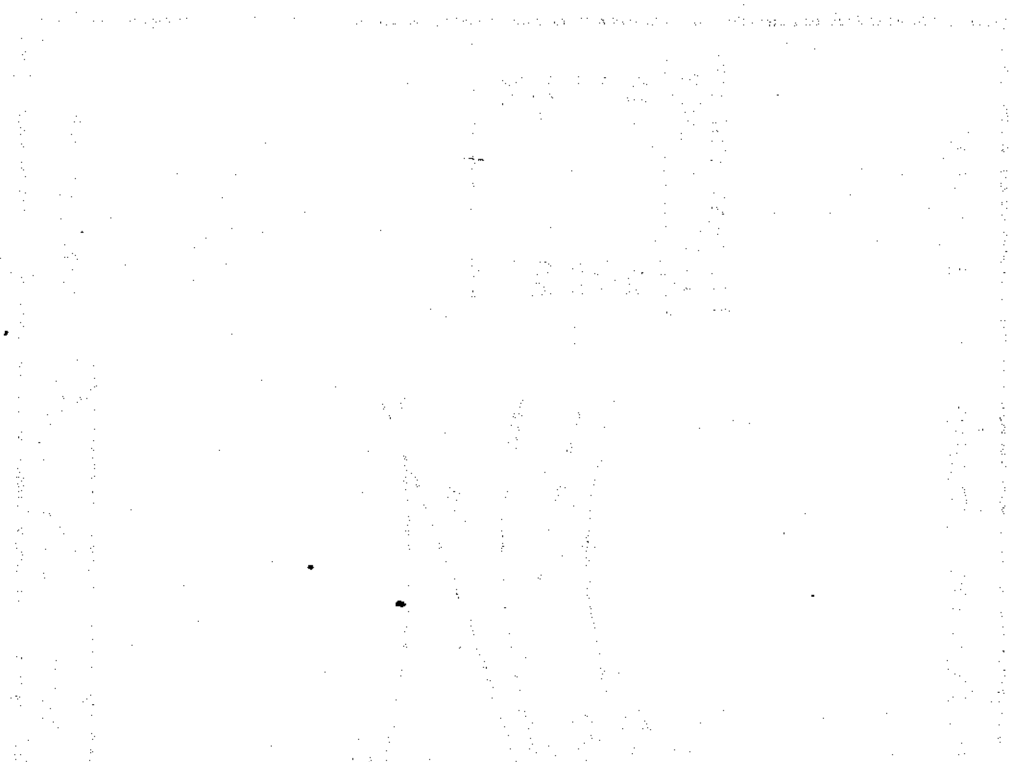
Fuels Used to Produce Electricity

The following illustration highlights the percentage share of power produced by various fuels for the four states in 1982.



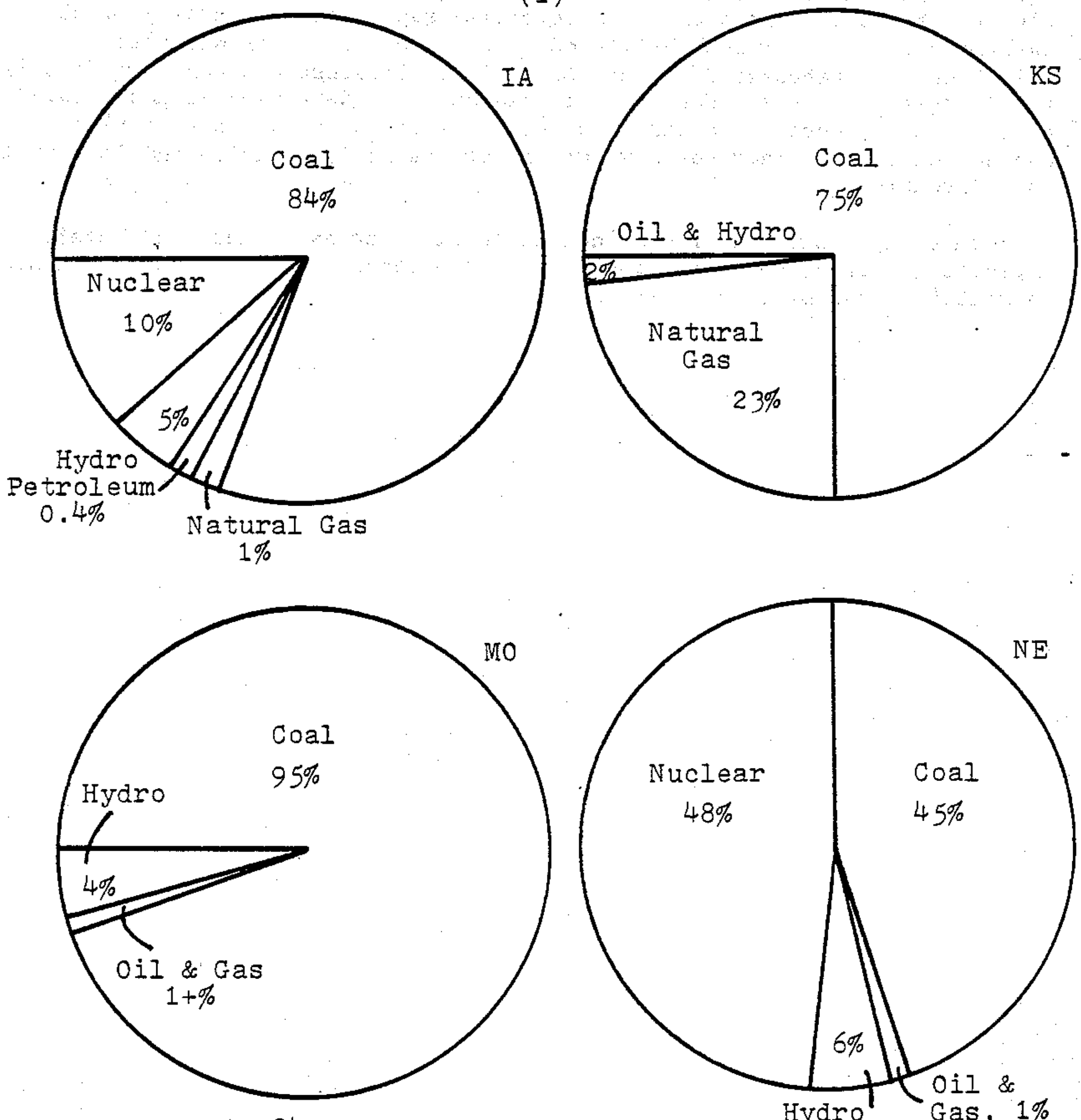
Coal has become the most important fuel used to generate electricity in the Region and in all four states. In Missouri around 95 percent of all electricity is generated with coal. In Nebraska, about 45 percent of the electricity is produced with coal.

Next to coal, nuclear power has become more important to the Region and particularly to Iowa and Nebraska as a power source. Nearly half of Nebraska's 1982 electricity production was produced by nuclear power.

Generally, natural gas, petroleum, and hydro power remain relatively minor sources of fuel to produce electricity in this Region. However, in Kansas in 1982 nearly one-quarter of this state's power production was by natural gas. Of course Kansas is a major natural gas producing state and tends to have historically low natural gas rates. These rates and abundant supplies of gas encouraged continued dependence upon natural gas when other states were discontinuing its use to produce power.

Absent major energy efficiency programs, it is expected in the near future that the Region will come to depend upon coal and nuclear fuels even more to meet electricity production needs as more power plants are built.

TYPES OF ENERGY USED TO PRODUCE ELECTRICITY, 1977-1982
(1)



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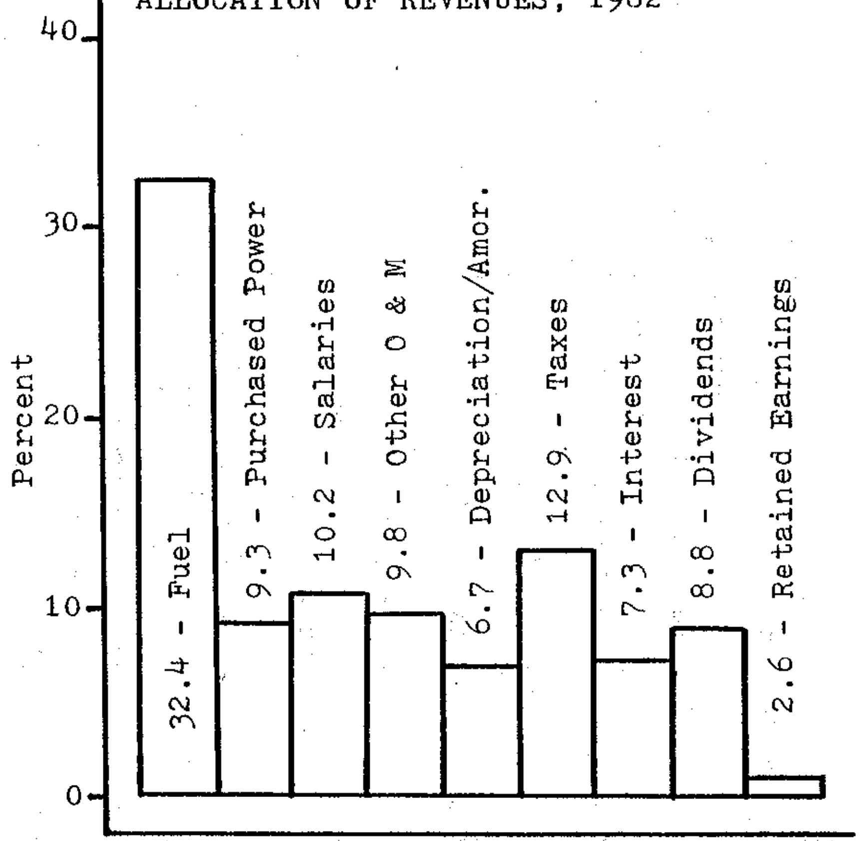
Electricity Revenue Allocations

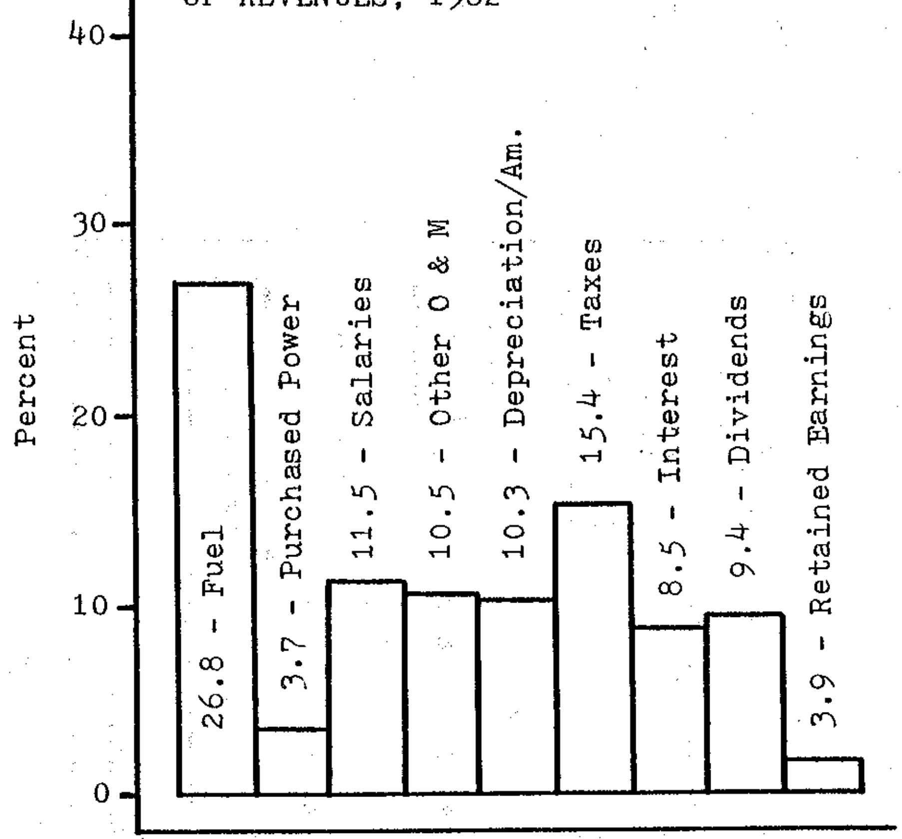
The illustrations on the following page provide for the United States and each of the four states in this Region estimates for how a dollar spent on electricity is in turn spent by electricity suppliers. Generally, fuel is the largest cost item for most utilities with the exception of Nebraska's utilities. In Nebraska debt service, primary interest on long-term debt is the largest cost item. For one Nebraska utility, debt service consumes 50 cents of every revenue dollar. In part this is due to Nebraska's high dependence upon nuclear power which is more capital intensive and less fuel cost intensive.

Other important cost items include local salaries, wages, and benefits for employees. Taxes, non-labor operation and maintenance costs, and dividends constitute other major cost items.

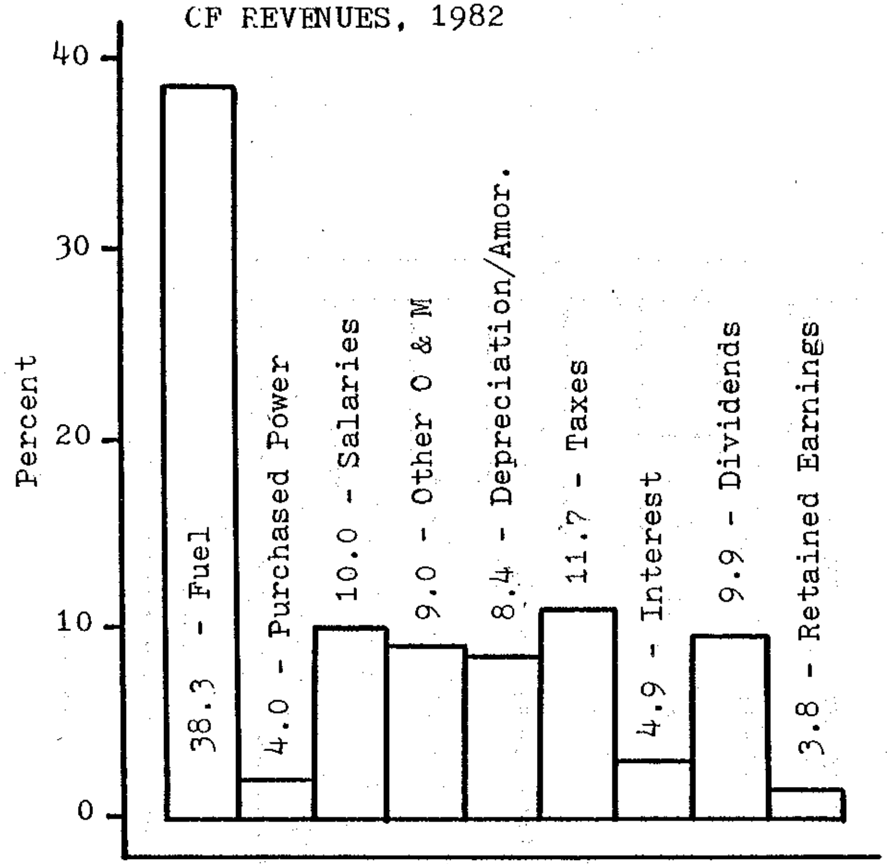
UNITED STATES AVERAGE ELECTRIC UTILITY ALLOCATION OF REVENUES, 1982



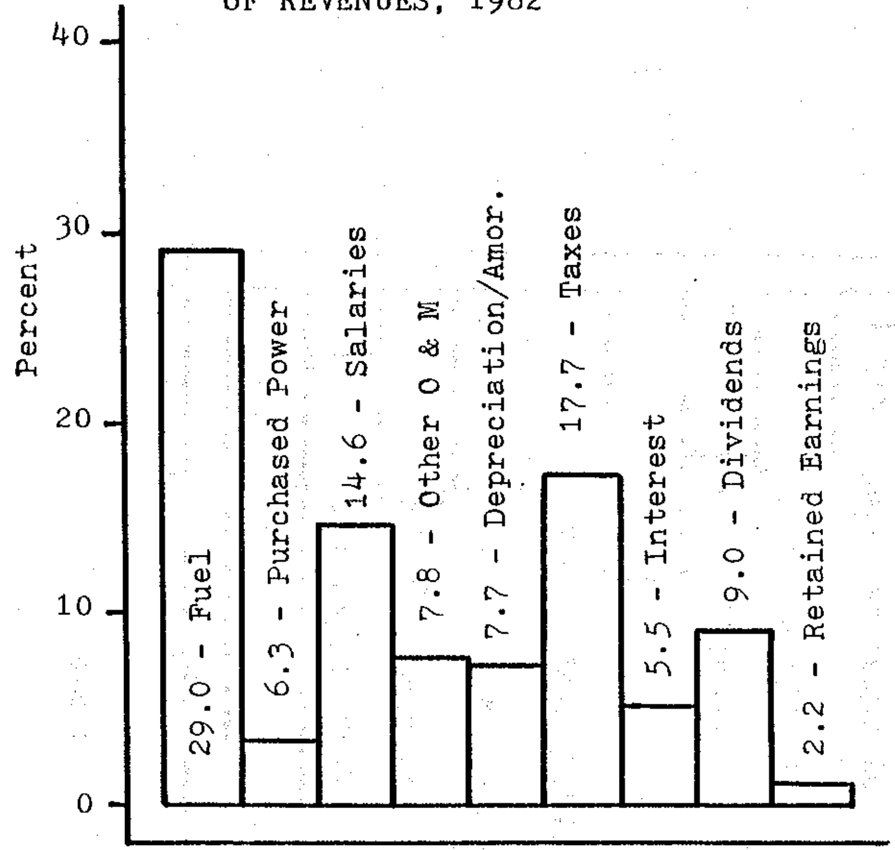
IOWA AVERAGE ELECTRIC UTILITY ALLOCATION OF REVENUES, 1982



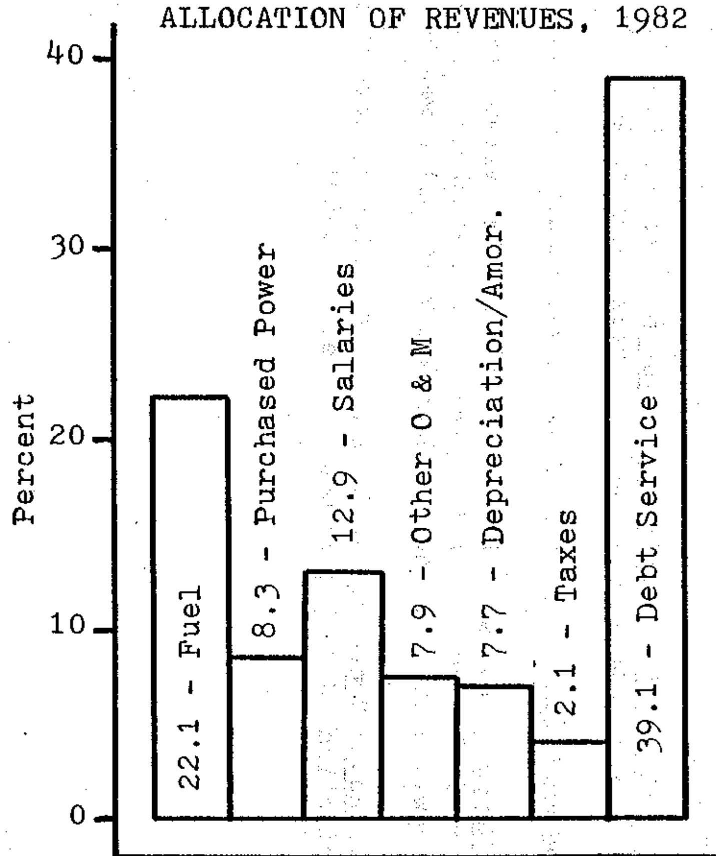
KANSAS AVERAGE ELECTRIC UTILITY ALLOCATION
CF REVENUES, 1982



MISSOURI AVERAGE ELECTRIC UTILITY ALLOCATION
OF REVENUES, 1982



NEBRASKA AVERAGE ELECTRIC UTILITY
ALLOCATION OF REVENUES, 1982



END NOTES TO THE PETROLEUM ANALYSIS SECTION

(1) State Energy Price and Expenditure Report 1970-1981. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, June 1984.

(2) State Energy Price Report, 1970-1982. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, August 1984.

(3) State Energy Data Report. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, May 1984.

(4) Monthly Energy Review. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, monthly.

(5) 1982 Electric Power Annual. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, August 1983.

(6) Financial Statistics of Selected Electric Utilities, 1982. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, February 1984.

(7) Financial Statistics of Public Electric Utilities, 1981. Washington, D.C.: Energy Information Administration, U.S. Department of Energy, February 1983.

(8) 1982 Statistics of Rural Electric Systems. Washington, D.C.: Rural Electrification Administration, U.S. Department of Agriculture, 1984.

(9) Selected municipal inquiries in Nebraska, Kansas, Iowa and Missouri.

(10) Annual Reports, for selected Nebraska electric systems including the Nebraska Public Power District, the Lincoln Electric System, the Omaha Public Power District, and the Nebraska Municipal Power Pool.

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4.6 CONSERVATION AND RENEWABLE RESOURCE ANALYSIS

The Savings and Investment Impacts

Two types of economic development impacts occur when energy efficiency techniques and renewable resources are employed. These are the savings and investment impacts. Savings to households from decreased energy bills increases household purchasing power. The multiplier effect of this increase in purchasing power will be equivalent to the general household multiplier. This is known as the respending effect.

A second economic development impact is the investment impact. This represents the economic effect that dollars invested directly in energy conservation have on local communities. These impacts can take the form or direct effects resulting from labor and materials purchased to install a conservation technique or to build, and operate and maintain a renewable energy system. Indirect effects accrue through the economic demand stimulus created by the increased purchases and wages paid to employees of alternative energy industries. Induced effects will occur from the spending of wages by the employees of these firms.

Passive Solar Retrofit

A passive conservation retrofit program for 1500 ft^2 house including the following measures would represent an investment of approximately $3,500.

Table 4-4

Residential Passive Retrofit

1500 ft^2 house

Item	Materials	Labor	Total Cost
R-38 Ceiling Insulation (fiberglass)	$ 420	$ 300	$ 720
R-13 Wall Insulation (blown cellulose)	375	375	750
Double Pane Storms	980	420	1,400
Furnace Retrofit	240	160	400
Infiltration Reduction	-	240	240
Thermostat--Time Control	80	-	80
TOTAL COST	$2,095	$1,495	$3,590

Source: SERI, A New Prosperity. Andover, Massachusetts: Brick House Publishing, 1981; construction contractor survey.

The use of passive conservation technologies is highly labor intensive. Passive conservation programs particularly demand jobs in installation, the most labor intensive area of job creation. In this case, example labor represents 42% of the retrofit costs. This corresponds to Rodberg's estimate of 35-50% as labor's share of a retrofit (Rodberg, 1980). As discussed earlier, the majority of these jobs are related to the installation phase. In this example, a 0.865 construction job-year was created, representing 24.09 jobs created per million dollars invested. Employment generated by conservation retrofit is allocated to Standard Industrial Code number 17 (SIC 17), Special Trades. Rodberg has found the Special Trades sector to contain input expenditures roughly proportional to sample solar industries (Rodberg, 1979). The following table presents coefficients and allocations to SIC industries.

Table 4-5

Allocation of Passive Retrofit Costs

Furnace Retrofit	Coefficient	SIC Allocation
Ceiling Insulation	.2006	1799 Special Trade
Wall Insulation	.2088	1799 Special Trades
Storm Windows	.3900	1799 Special Trades
Furnace Retrofit	.1114	1711 Furnace Repair
Caulking	.0669	1799 Special Trades
Thermostat	.0223	5251 Retail Hardware
Total	1.0000	

These coefficients represent per dollar investment in a residential retrofit. Ceiling and wall insulation combined represent the largest share of the costs. In addition to the industries listed above, conservation retrofit would likely have indirect employment effects on the following SIC sectors.

Table 4-6

Indirect Employment from Investment in Conservation

SIC	Description
	Retail
5211	Insulation products, storm windows
5251	Hardware
	Wholesale
5039	Fiberglass and Cellulose Insulation
	Manufacturing
3822	Thermostats
2823	Cellulose
3229	Fiberglass
2891	Caulking Products
3442	Metal Storm Windows
3433	Heating Aparatus

The respending effect would be reflected by the household multiplier since savings generated through lower energy bills offers the household greater purchasing power. Additionally, increased retrofit activity might spawn the development of a major industry specializing in all aspects of the retrofit: audits, retrofits, and financing.

Residential Conservation

The following table indicates the "leakages", or percent of dollars invested in the conservation retrofit outlined in Table 4-3 that leave economies of the states in Region VII.

Table 4-7

Conservation Retrofit--State Leakages

Percent of Dollar Invested Spent Out-of-State

Item	Iowa	Kansas	Missouri	Nebraska
Ceiling Insulation				
Labor	0.000	0.000	0.000	0.000
Material	1.000	0.578	1.000	1.000
Wall Insulation				
Labor	0.000	0.000	0.000	0.000
Material	1.000	1.000	0.835	1.000
Storm Windows				
Labor	0.000	0.000	0.000	0.000
Material	0.330	0.659	0.448	0.150
Furnace Retrofit				
Labor	0.000	0.000	0.000	0.000
Material	0.417	0.420	0.900	0.794
Caulking				
Labor	0.000	0.000	0.000	0.000
Material	0.895	0.369	0.478	0.812
Thermostat				
Labor	0.000	0.000	0.000	0.000
Material	0.250	0.973	0.700	0.643

Source: U.S. Department of Commerce, Census of Transportation, Commodity Transportation Survey, 1977; U.S. Department of Commerce, Census of Manufacturers, State Reports, 1977.

The total share of expenditures spent out-of-state were: Iowa, 34.5%; Kansas, 40.2%; Missouri, 39.9%; and Nebraska, 33.0%.

Manufacturing products tended to have high leakage rates. Insulation materials, representing over 20% of the cost of the retrofit, had very high leakage rates. Iowa and Nebraska had 100% leakages in both fiberglass and cellulose products. Kansas and Missouri, while having some in-state manufacturing, still had very high leakages. Leakages for manufactured products were estimated from trade flows reported in federal census documents. These leakage estimates could be refined through state specific surveys.

The labor expenditures were all assumed to have no out-state leakages. Each state thus had a leakage rate of zero.

From these data output multipliers for each state were developed. The Burford-Katz methodology for development of local economic multipliers was used (Burford and Katz, 1981). The following table depicts the multipliers for Region VII states.

Table 4-8

Economic Multipliers
Conservation Retrofit Example

State	Per Cent In-State Expenditures	Multiplier
Iowa	0.6550	2.3839
Kansas	0.5984	2.2643
Missouri	0.6066	2.2816
Nebraska	0.6703	2.4162

The labor expenditures alone had multipliers of 1.88; thus approximately 80% of the multiplier effect in each state was due to the low leakage value of labor. The states were each aided by the presence of fabricated steel industries for the manufacturing of storm windows. Nebraska's slightly higher multiplier may be a reflection of the concented presence of storm window manufacturers in the state.

Employment Impact

Energy efficiency and non-conventional alternatives offer an array of job creation possibilities. These cover a spectrum from highly-skilled to low- or unskilled positions from the low end to the upper end of wage scales. Additionally, they may occur in both centralized and decentralized industries.

For example, technologies such as an ethanol production plant or a photovoltaic generating plant may employ a professionally trained design engineer in a central location. On the other hand, a superinsulation retrofit is a decentralized activity that may require a skilled tradesman.

The training and skills necesary to install and operate alternative energy systems will vary considerably depending upon the sysstem. Most jobs created will require some skill. Development of small solar systems will enhance job opportunities for construction labor while larger industrial and community solar systems may require much more professional labor, roughly proportrional to those skills required for construction of conventional power generating facilities (Schachter, 1978).

Since there are many similarities among the skills required for conservation and conventional building, trades, and manufacturing, these latter industries can be used as "surrogates" to estimate the characteristics of the direct employment generated through investment in conservation. Specifically, the Residential and Commercial Building Construction sector and the Special Trades Construction sector can be used as surrogates for the conservation and solar industries. Investment in larger scale renewable systems, such as geothermal energy or ethanol production would be similar to the Heavy Construction sector. Indirect employment would be generated in those industries supplying iniputs to the primary construction industries.

Types of direct and indirect jobs which would be created through increased investment in energy efficiency and renewables would fall within these SIC categories.

Table 4-9

Direct and Indirect Job Creation
Through Investment in Energy Conservation

SIC	Description
	Construction
152	Residential Building Construction
1542	General Contractors--Nonresidential Buildings Other than Industrial Buildings and Warehouses
1629	Heavy Construction, nec.
171	Plumbing, Heating, A/C
173	Electrical Work
1793	Glass and Glazing Work
1799	Special Trades, Misc.
	Manufacturing
2823	Cellulosic Manmade Fibers
2891	Adhesives and Sealants
3211	Flat Glass
335	Nonferrous Rolling and Drawing
343	Plumbing & Heating, exc. Electrical
344	Fabricated Structural Metal Products
3442	Metal Doors, Sash and Trim
3585	Refrigeration and Heating Equipment
3643	Current Conducting Wire Devices
3822	Environmental Controls
	Wholesale Trade
503	Lumber and Construction Materials
5031	Lumber, Plywood, and Millwork
5039	Construction Materials
5063	Electrical Apparatus and Equipment
507	Hardware Plumbing and Heating Equipment
5072	Hardware
5074	Plumbing and Heating Equipment Supplies
5075	Warm Air Heating and Air Conditioning Supplies
5078	Registration Equipment and Supplies
	Retail Trade
521	Lumber and Other Building Materials
525	Hardware Stores

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