The Attitudes of Illinois Petroleum Jobbers About the Marketing of Propane

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THE ATTITUDES OF
ILLINOIS PETROLEUM JOBBERS
ABOUT THE MARKETING OF PROPANE

Honors College
Senior Paper
Western Michigan University

Prepared by
Dale E. Houston
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PREFACE

This study was motivated by my own curiosity about propane. Since I had practically no prior knowledge of the subject, each day I worked on this paper found me learning many things about a complex area of petroleum marketing.

I confined the scope of my study to the state of Illinois because I intend to return there to work in petroleum marketing. The research results, conclusions and acceptance or rejection of hypotheses of the study are based on data compiled from a personal interview questionnaire. (A copy of the questionnaire is located in Appendix B.) One hundred of the questionnaires were completed by members of the Illinois Petroleum Marketers Association at their March 24-26, 1980 convention.

The support, encouragement, and aid of many individuals made completion of this project possible. I would specifically like to thank the following: Brian Peters, who loaned me the typewriter; Thomas Coady, John Flessner, and John Hartzell, who all provided me with valuable information about propane; the members of the Illinois Petroleum Marketers Association who completed my questionnaire; Dr. Linda Delene and Dr. Jack Humbert, who both guided, corrected, and aided me greatly; and Gale Whiting, who was an excellent teacher’s aide.
PURPOSE

The purpose of this study is to identify the attitudes of Illinois petroleum jobbers about the marketing of propane.

HYPOTHESES

The hypotheses of this study are as follows:

1. A hypothesis of this study is that the percentage of Illinois petroleum jobbers marketing propane will increase due to the fact that propane sales will increase jobbership profitability.

2. A hypothesis of this study is that the Illinois propane market is expanding due to the fact that propane is less expensive than gasoline.

3. A hypothesis of this study is that fuel oil sales in rural Illinois are decreasing due to the fact that propane furnaces are less expensive to install than fuel oil furnaces.

4. A hypothesis of this study is that fuel oil sales in rural Illinois are decreasing due to the fact that propane furnaces are less expensive to operate than fuel oil furnaces.

5. A hypothesis of this study is that Illinois petroleum jobbers have the belief that propane has a "poor" future as a motor fuel.
SITUATION ANALYSIS

History of the Petroleum Industry

On the morning of October 16, 1973 twelve men shattered nearly thirty years of relative calm in the oil industry. Although oil had frequently been embroiled in periods of turbulence, the final quarter of 1973 gave the oil business and Western consuming nations a shock, this shock finally began wearing off nearly six years later.

That eventful October day witnessed an unanimous vote of the oil ministers of the Organization of Petroleum Exporting Countries (OPEC) to raise the price for OPEC's marker crude oil by about 60 percent. This marker crude oil, Saudi Arabian light, is the optimum OPEC crude oil for producing gasoline. The Saudi Arabian light crude oil went up from .072¢ per gallon to over .12¢.¹

The next day, the Organization of Arab Petroleum Exporting Countries (OAPEC) met to decide how to aid Egypt and Syria. These two countries had attacked Israel earlier in the month, and were being soundly defeated. OAPEC members were infuriated by material and moral support that the United States and various Western European nations were providing Israel. Therefore, this meeting resulted in an immediate five percent cut in OAPEC production. These ministers

declared that the same percentage decrease in crude production per month would be applied until two conditions were met. The conditions were: (1) Israel's withdrawal from all territory occupied during the Six-Day War, and (2) acknowledgement of the Palestinian's legal rights. The embargo had no intended connection with the overall OPEC price increases, but was conceived solely in response to the October War. "It had nothing to do with wanting to increase the price of oil," the then OPEC secretary Ali Atiga commented, "It was meant to attract the notice of the public in the West to the Israeli question..." However, the results of this now historic embargo made all the OPEC member nations conscious of a change in world oil demand. The world had changed from a crude oil buyer's market to a crude oil seller's market.

Members of the oil industry vividly remember the problems that the embargo ushered into the consuming Western countries and Japan. Gasoline service stations from Rome to Chicago to Tokyo suddenly were besieged by huge lines of cars. These auto owners wished to "top-off" the car gas tanks to avoid shortages. This panic buying caused shortages of gasoline and abbreviated hours at the corner gasoline service station. Prospects of a shortage of fuel oil to heat homes and businesses during the nearing winter months became realistic, a throw-away economy that was promoted during the late

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3 Ibid, p. 302.
1960's was also dependent on petrochemicals. Common market nations and Japan began to formulate energy policies. In the United States, the Congress formed the Federal Energy Agency to allocate petroleum products and to study the entire energy situation. Little did the consuming nations know, the worst was yet to come from OPEC.

OPEC's regular December meeting was nearing, and the question of whether the price of OPEC crude would go up or down appeared in the Western press time and again. The speculation was answered on December 22 when the ministers voted to raise the marker crude from its October 16 figure of .12¢ per gallon to over .275¢. In three eventful months the market price had increased nearly four-fold (from .072¢ on October 1 to .275¢ on January 1, 1974).\(^5\) In only three months, oil, a vital life-giving elixir of the Western industrialized economy, had changed its traditionally stable status to a controversial one.

Such cataclysmic changes had been common in the oil industry. From its infancy in Pennsylvania in the 1840's until 1973, this business had constantly witnessed widely varied peaks and valleys.

The beginning of the American oil industry can be traced back to Samuel M. Kier of Pittsburgh. Kier was intrigued by petroleum found in his uncle's 400 foot deep salt wells in Titusville, Pennsylvania. Being an enterprising entrepreneur, Kier decided to use the petroleum to enter what was then, (1947), an extremely profitable

\(^5\)McCaslin, op. cit., p. 39.
field—home remedies. A sales poster extolls the petroleum as, "A Remedy of Wonderful Efficacy" [sic]. The poster continues by stating that, "The Petroleum Has Been Fully Tested," [sic], and "The lame were made to walk--the blind to see." Rheumatism, gout, and neuralgia [sic] were among the ailments this, "Most Wonderful Remedy Ever Discovered" [sic], was capable of curing. Bottles of this new medicine sold quickly for a short time, but soon Kier found the "Rock Oil" would not sell at all.

However, Kier was no quitter. Remembering that the petroleum would burn, Kier decided to change the marketing strategy for selling petroleum. A major problem with this idea was the fact that the crude petroleum smoked horribly when burned. Following much experimentation, Kier discovered that a diaphanous liquid could be distilled from the petroleum. The liquid, which Kier named carbon oil, burned very cleanly, had no offensive odor, and was very inexpensive to produce. Shortly after producing the first batch of carbon oil in 1850, Kier built a larger still and was shipping the primitive kerosene throughout Pennsylvania and as far east as New York City. Kier began selling the carbon oil for seventy-five cents per gallon, but increasing demand soon prompted increases in price to two dollars per gallon.

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7Ibid., p. 2.
8Ibid., p. 1.
By 1859 much of the oil that was simple to recover was gone. This was oil located floating on water ponds and in salt wells. That fact prompted the Seneca Oil Company to hire Edwin L. Drake to attempt using a then untried method of procuring oil—drilling. Drake employed a cable tool drilling rig to fulfill the task. The rig components included a 40-foot drilling tower and a 10-12 horsepower engine. Drake deployed the rig in an oil spring outside of Titusville. Saturday, August 27, 1859, Drake and his crew began experiencing difficulty with the rig. Finally, after removing the bit from the well, a green goo began oozing from the well-head. At a depth of 69½ feet Drake had struck oil.

As news of Drake's discovery spread, numerous speculators began forming oil companies and leasing land for drilling operations in Western Pennsylvania. These new oil companies confined drilling to old geological formations such as folds and faults. Drilling in younger formations was attempted, but usually failed miserably as the formations yielded either water, methane gas, or both. Due to the fact that the original drilling success was along the Appalachian

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10 Class lecture of Mr. Larry Williams, Department of Distributive Education, Western Michigan University, Kalamazoo, Michigan, 1978.

11 Brantly, op. cit., p. 163.

12 Giddens, op. cit., p. 6.
fold belts in Pennsylvania, drillers concentrated on areas in Western Pennsylvania. Quickly this area along the Allegheny River was embroiled in a massive "oil rush." Boom towns such as Pithole, Oil City, and Oleopolis sprang up to supply the oil fields with equipment, supplies, and lines of communication. By 1960 oil cost ten cents a barrel. In a short two years the drillers had produced a phenomenon that would occur many more times throughout the history of the oil industry—a glut.

The glut forced prices to the consumer even lower and created an even greater demand for petroleum products. In 1965 a writer declared that petroleum, "... lights our dwellings, lubricates our machinery, and is indispensable in numerous departments of arts, manufactures, and domestic life." The writer continued on by declaring that "... to be deprived of it (oil) now would be setting us back a whole cycle of civilization." America was reliant on oil, and this reliance fostered the early driller's "hope for a magnificent future." The pioneering hope of early drillers and investors enabled the infant industry to expand, in spite of alternating gluts

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14Sampson, op. cit., p. 23.
15Ibid., p. 25.
16Ibid., p. 24.
17Ibid.
and shortages, and huge fires, such as the one that destroyed the entire town of Oil City in 1892.\textsuperscript{18}

Drilling activities had expanded to many parts of the world by the turn of the century. In 1873 an oil field that seemed more extensive than Pennsylvania had been discovered in the Russian Caucasus.\textsuperscript{19} The Royal Dutch Oil Company had drilled a series of successful wells in the Dutch East Indies in 1890.\textsuperscript{20} These wells had all been sunk in old geologic formations.\textsuperscript{21} However, Anthony Lucas, a young geologist felt that salt domes, which are young geologic formations, were promising locations for oil wells.\textsuperscript{22} This idea motivated Lucas to buy an interest in the Gladys City Oil, Mineral, and Manufacturing Company in 1899.\textsuperscript{23} This company owned drilling rights to 33 acres of land located above salt domes near Beaumont, Texas.\textsuperscript{24} One of these domes, Spindletop Hill, regularly emitted marsh gas (methane).\textsuperscript{25} The Gladys City Company had been drilling on that parcel of land without

\begin{itemize}
\item\textsuperscript{18}Ibid., p. 25.
\item\textsuperscript{19}Ibid., p. 54.
\item\textsuperscript{20}Ibid., p. 56.
\item\textsuperscript{21}Press and Siever, \textit{op. cit.}, p. 837.
\item\textsuperscript{23}Ibid.
\item\textsuperscript{24}Ibid., p. 17.
\item\textsuperscript{25}Ibid., p. 18.
\end{itemize}
success since the company was formed in 1892.\(^{26}\) Lucas purchased the controlling interest in the company in 1900 to save it from bankruptcy caused by the lack of drilling success.\(^{27}\) Therefore, at the urging of Lucas, a new 1100 foot well was started at Spindletop in the spring of 1900. Al and Curt Hamill and Peck Byrd, were hired to sink the well for two dollars a foot.\(^{28}\) The Hamill brothers used a 60-foot high derrick with a 20 square foot base.\(^{29}\) The rotary drilling rig employed a 25 horsepower boiler to operate an 18 horsepower engine. The engine provided enough power to rotate a 16 inch bit, although ten and eight inch bits were used for the final 970 feet of the well.\(^{30}\) Following months of drilling, oil began oozing from the drill casing early on January 10, 1901, at a depth of 1020 feet. A short time later a pressurized stream of crude oil began gushing to 100 feet above the derrick in a six inch wide stream.\(^{31}\) Lucas estimated the great gusher to be flowing at 30,000 barrels per day, but later the true figure was determined to be nearly 100,000 barrels.\(^{32}\) The Hamill brothers constructed a

\(^{26}\) Ibid., p. 24.
\(^{27}\) Ibid., p. 29.
\(^{28}\) Ibid., p. 44.
\(^{29}\) Brantly, op. cit., p. 230.
\(^{30}\) Ibid.
\(^{31}\) Clark and Hallouty, op. cit., p. 55.
\(^{32}\) Ibid., p. 60.
simple device (the first blow-out preventer), consisting of three valves, to control the gusher. When installed, this device successfully controlled the largest oil well blowout that had occurred in the United States.33

The wonderous success of the Lucas well brought numerous drilling companies to the East Texas area. These new drillers, who were seeking to emulate the Lucas strike and the workers, refineries, and railroads that accompanied them, permanently transformed that part of Texas. Another "oil-rush" was taking place, and as with other "oil-rushes" throughout the world, this transformation would last as long as the oil did. By this time the Pennsylvania fold belt wells were beginning to dry up. As the wells stopped flowing, the new oil companies moved on to new prospects. Some of these new areas produced only dry holes, but others were successful. The areas that ceased flowing oil or produced no oil at all were quickly abandoned by the oil drillers. Great boom towns such as Pithole, Pennsylvania, (at its peak the home of 10,000 inhabitants, eight hotels, and two telegraph offices), simply "dried up and blew away."34

The areas that did produce oil fed the voracious appetites of the growing, young, energetic oil companies. These companies sought oil to produce kerosine for use as an odorless, smokeless illuminant.35

33Brantly, op. cit., p. 237.
34Sampson, op. cit., p. 23.
After finding the oil and refining the kerosine and various lubricants, the products were marketed. World War I and Henry Ford's Model T automobile necessitated large scale growth in gasoline, aviation fuel, and lubricant production. World War II and the temporary inaccessability to natural rubber that accompanied the war forced growth of petrochemicals, besides the three other areas of petroleum production. Postwar increase in consumption provided the oil companies with a stiff test of existing production facilities. The number of farm tractors and road vehicles climbed by one half between 1945 and 1950 and domestic oil burners doubled in number.\textsuperscript{36}

Increases in the market for refined products brought about fierce competition among oil companies. During the 1950's a mad scramble took place for the agricultural market throughout the country. A rush for corners along highways around the world was taking place as various companies attempted to increase volume. Credit cards provided additional incentive to motorists to travel and burn gasoline. Advertising became important as oil companies turned to the radio and television waves to deliver slogans and product news to the motoring and home heating public. Texaco even put gasoline service stations in all 48 of the continental United States.

One common trait of this period was the relatively stable price structure. Although isolated price wars were common, no major company ever made waves long because it served to hurt all involved.

\textsuperscript{36}Ibid.
For nearly 25 years the price of a gallon of gasoline or fuel oil did not fluctuate over 20 cents.

This situation continued until 1973. OPEC forced a change in pricing by initiating the first increases in the price of crude oil in nearly twenty years. Although OPEC had been in existence for over ten years, the oil producing nations had not fully realized their power until October 1973. Finally, the keynote statement made by Perez Alfonso, Venezuela's oil minister, at OPEC's organizational meeting in Caracas in September, 1960 was being fulfilled. He declared that, "We have formed a very exclusive club ... Between us, we control ninety percent of crude exports to world markets, and we are now united. We are making history." Anthony Sampson used this quote in his book, *The Seven Sisters*, to illustrate the beginning of the transfer of power from the Western consuming nations to producing nations.

In 1974, energy policies started to be implemented in industrialized countries. By 1976, Britain was working hard to conserve petroleum, to cut imports, and, most importantly (and most costly, too), developing the North Sea oil fields. This latter factor was vital because there was enough oil to supply Britain and have a surplus. Now the British government was thinking congruently to OPEC (keep prices up to discourage consumption and maximize profits). The vast amounts of money necessary to develop the oil fields did not seem to trouble this economically troubled country as over
$700 million was raised during the first half of 1976. Norway and Denmark were in high spirits over North Sea fields too, and steered the same course as Britain in energy policy. The American Congress talked a lot and ordered several studies. The studies resulted in allowing the Alaska pipeline, a 55 mile per hour speed limit, a new Federal Energy Office, and continued mandatory allocation of petroleum products to retailers. Most radical of all, American autos were redesigned to achieve fuel efficiency in 1977.

These measures did little to decrease consumption as worldwide use of oil continued to increase. Each increase in consumption has been met by OPEC's December price increases. In fact, 1978 and 1979 saw gasoline prices rise to over a dollar per gallon in the United States but, consumption still increased. As the price of gasoline has risen, consumers and government are looking seriously at alternatives. The electric car has been redesigned, gasohol became important in the grain belt, American automakers are building diesel auto engines, a national billion dollar synthetic fuel company is on the news daily, and the Carter Administration gave birth to the Department of Energy.

**History of the Propane Industry**

Liquid petroleum gas is a rising alternative to gasoline and fuel oil. Propane is especially attractive because a few minor adjustments to a regular internal combustion engine will allow it to

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burn propane. Home owners can use propane for heating houses that are located at a distance from natural gas mains making propane a great boon to rural homeowners. This fuel can also be used to operate ranges, clothes dryers, and water heaters.

Propane is a by-product of the petroleum industry that can be obtained in two ways. All petroleum wells yield a percentage of propane mixed with other liquid gasses and the crude oil or natural gas. Fractional distillation in petroleum refineries yields propane in upper level distillation. In the United States 70 percent of domestically produced propane is from wells and the remaining 30 percent is from refining.  

The beginning of the propane industry can be traced back to Germany in 1890 when Pintsch gas, a mixture of methane and hydrocarbon gasses was compressed rather than liquified. Refinements in identification and isolation of the many gaseous and liquid compounds present in casinghead gas resulted in the discovery of propane by the United States Bureau of Mines. At an ever-increasing pace, propane moved into suburban and rural markets and portable applications. The industry grew with the increase in business by broadening applications, refining its product, training employees and customers in safe practices, developing new equipment, and shifting from small volume cylinder distribution to bulk transport and storage.

38 Tom Lambert, Lecture given at Western Michigan University, November, 1980.
OPEC price increases since 1973 struck gasoline and fuel oil companies (and consumers) with great force. An energy conscious American public formed in response to the price increases. Congress and the public both desired an energy policy independent from Middle Eastern oil. Analysts estimated however, the price of such an endeavor proved staggering. An over one trillion dollar investment would be required to keep the non-communist world in its own oil. Price tags such as this forced a look at alternatives to gasoline and fuel oil. The winter of 1976-77 observed a huge leap in propane use as an industrial alternative to natural gas. Two years later the rising cost of fuel oil and electric heat caused homeowners to begin converting to natural gas and propane heating systems.

The trend toward conversions reached enormous proportions nation-wide during 1980 as fuel oil prices neared the dollar a gallon mark. A representative of Empiregas in New Hampshire commented that, "Business has increased 60 percent in the last six months. People are installing propane water heaters, clothes dryers, and heating systems." The heating conversions from fuel oil were


40Bruce Andrews, "$1 Trillion to Meet Oil Needs," The Oil Daily, Jan. 6, 1977, p. 4.


evident during the winter of 1979-80 as fuel oil volume was down 22.7 percent nation-wide. Companies with truck and car fleets are turning away from gasoline to propane to fuel vehicles. Southern Bell of Florida has 3,400 propane powered units and the City Public Service Board of San Antonio has between 300 and 400 vehicles operating with propane. Since May, 1980, all appliance manufacturers have been required to affix energy labels on all new clothes dryers, water heaters, ranges, and furnaces. These labels reveal the cost of yearly operation according to various base prices for propane, natural gas, and electricity. The price of natural gas and propane make operation of these major appliances much more economical than electricity.

Coupled with the rising costs of gasoline, fuel oil, and electricity, and its availability and competitive price, the marketing of propane has a favorable future. This future includes numerous commercial and private applications.


TERMS

In order to be precise, this study, Identification of the Attitudes of Illinois Petroleum Jobbers About the Marketing of LP-Gas, must employ numerous technical terms. Definitions of these terms are as follows:

1. Antiknock: The smooth, even burning quality of a gasoline during internal combustion.46

2. Bobtail: A propane bulk truck based on a straight truck chassis.47

3. Carbon Monoxide: A noxious compound consisting of one atom each of carbon and oxygen; a by-product of internal combustion.48

4. Converter: A device to depressurize and heat liquid propane (LPG) in order to vaporize the liquid.49

5. Department of Energy (DOE): A department established in 1977 that exercises primary responsibility for policies, programs, and administration in the field of energy.50

6. Department of Transportation: An agency created to develop national transportation policies and programs to achieve efficient and safe transportation at low cost.51


51 Ibid., p. 330.
7. Dual-Fuel: An internal combustion engine modified to operate on one of two different fuels. (For this report the fuels will be gasoline or propane.)

8. Emergency Shutdown Valve (ESV): A safety device located in a bulk plant loading area to close off all storage tanks in the plant.


10. Gas Processing: The actual action of removing hydrocarbon gases from crude oil; purifying the gases.

11. Gas Research Institute (GAI): A nonprofit science foundation dedicated to research involving the uses of petroleum gases.


13. Illinois Department of Transportation (IDOT): The agency involved in regulation of all transportation matters in the State of Illinois.

14. Jobber: A market intermediary in the oil business who purchases large quantities of petroleum products from manufacturers and sells the products in smaller quantities.

52 Mort Schultz, "Answers to the Questions About Converting Your Car to Propane," Popular Mechanics, CLVII (September, 1979), p. 48D.


57 Seese and Daub, op. cit., p. 558.


59 Humbert and Williams, op. cit., p. 185.
15. **Liquified Natural Gas (LNG):** Methane cooled to -260° F. and pressurized at 100 psi to liquify it.\(^6^0\)

16. **Liquified Propane Gas (LPG):** Propane gas pressurized to 100 psi to liquify it.\(^6^1\)

17. **Mcfd:** Million cubic feet per day.

18. **MMcfd:** Trillion (one thousand millions) cubic feet per day.\(^6^2\)

19. **National Liquified Petroleum Gas Association (NLPGA):** A national trade association of companies that market propane and other liquid petroleum gases.\(^6^3\)

20. **Natural Gas (Methane):** A hydrocarbon consisting of one carbon atom and four hydrogen atoms; a vapor at room temperature, but, if cooled to -260° F. and pressurized to 100 psi the methane will liquify.\(^6^4\)

21. **Occupational Safety and Health Act (OSHA):** A comprehensive industrial safety program which requires employers engaged in interstate commerce to furnish a work place free from hazards to life or health.\(^6^5\)

22. **Octane:** A measure of the antiknock quality of a hydrocarbon motor fuel.\(^6^6\)

23. **Odorant:** Chemical added to gas to provide it with a well-defined scent.\(^6^7\)

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\(^6^0\) Seese and Daub, op. cit., p. 562.

\(^6^1\) Ibid., p. 454.


\(^6^4\) Seese and Daub, op. cit., p. 454.

\(^6^5\) Plano and Greenberg, op. cit., p. 350.

\(^6^6\) Humbert and Williams, op. cit., p. 185.

24. Propane: A hydrocarbon consisting of three carbon atoms and eight hydrogen atoms. A vapor at room temperature, if pressurized to 100 psi it changes to liquid for transportation or storage (LPG).68

25. Psi: A pressure measure abbreviation for pounds per square inch.69

26. Research and Development (R&D): All testing and pre-production work devoted to a new product.70

27. Service Station: A business establishment where the greatest portion of the operator's income is derived from sales of motor fuel, auto parts and accessories, and auto maintenance.71

28. Spit Valve (Pressure Relief Valve): A safety device that allows excess pressure to escape from storage tanks.72

68 Seese and Daub, op. cit., p. 454.
69 REGO Company, op. cit., p. 3.
71 Humbert and Williams, op. cit., p. 185.
Handling and Storage

When propane either leaves a petroleum well or a petroleum refinery, the propane is in a gaseous state. The propane is then transported either as a gas or a liquid to a marketing intermediary. The marketing intermediary stores and transports the propane as a liquid to an end user. The end user stores the propane as a liquid and uses it as a gas. Since propane is required to change phases three times between point of origination and end use, special handling and storage procedures are necessary for propane. 73

At room temperature and pressure propane is a hydrocarbon gas composed of three carbon atoms and eight hydrogen atoms. 74 This propane gas weighs more than air. Therefore, if released from a container, the gas will fall and collect rather than rise and dissipate, as a gasoline vapor. As a gas, propane must be transported by pipeline, in a manner similar to methane (natural gas). Pipeline transportation of gaseous propane is the least expensive manner to move large volumes of propane. Many pipeline companies transport propane throughout the United States. 75 Figures 1 and 2 show the system of two major pipeline companies.

73 Mr. Tom Lambert, Lecture at Western Michigan University, November, 1980.

74 Dr. George G. Lowry, Class Lecture, Chemistry Department, Western Michigan University, Kalamazoo, Michigan, December 9, 1980.

75 Lambert, op. cit.
If pressurized, propane will liquify. Pressurization also decreases the temperature and volume of the propane. When 100 pounds per square inch (psi) of pressure is applied to propane it will liquify and decrease in temperature to \(-32^\circ\text{F}\). The relation of pressure and temperature to the volume of liquified propane is of vital importance. The withdrawal of propane vapor from a storage container lowers the pressure contained within the container. This causes the liquid to boil in an effort to restore the pressure by generating vapor to replace that which was withdrawn.

The heat lost due to the vaporization of the liquid is replaced by heat in the air surrounding the container. This heat is transferred from the air through the metal surface of the container into the liquid. Heat is transferred through the surface area of the container that is bathed in liquid. The greater the wetted surface of the container, the greater the vaporizing capacity of the container. Therefore, the worse conditions for vaporization are when a container holds a small amount of liquid and the outside air temperature is low.

76 Lowry, op. cit.
78 Lowry, op. cit.
FIGURE 2

TERMINAL MAP
HYDROCARBON TRANSPORTATION INC.
2223 DODGE ST.
OMAHA NEBRASKA 68102

LEGEND

▲ ORIGINATION POINT
● TERMINAL
— CONNECTING CARRIER
Storage of liquified propane is most efficiently accomplished in pressurized steel tanks. Propane tanks are constructed of curved steel because the interior walls are then naturally compressed. The pressurized propane must buckle these compressed walls to burst the storage tank.  

Propane storage tanks range in size from huge domes that contain thousands of gallons to small hand-held containers for barbecue grills and camping equipment that hold ten to fifteen gallons.  

All propane storage containers must meet stringent regulations stated in the National Fire Protection Association (NFPA) Pamphlet 58. The National Fire Protection Association Pamphlet 58 requirements for propane storage containers vary according to the size and use of the container. Any portable container must meet regulations drafted by the Department of Transportation. These regulations state that connections must be recessed into the container so that valves will not be struck if the container is dropped on a flat surface. The regulations require a ventilated cap or collar designed to permit adequate safety relief valve discharge and capable of withstanding a blow from any direction equivalent to that of a 30 pound weight dropped four feet. Construction of the container shall be such

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80 Lambert, op. cit.
that the force of the blow will not be transmitted to the valve. Container collars shall be designed so that they do not interfere with the free operation of the cylinder valve. In spite of these rigid regulations, questions exist in regards to the safety of propane motor fuel systems. The Blue Bird Body Company has serious doubts as to the safety of propane systems. In fact, this company refuses to mount a Blue Bird school bus body on a chassis powered by a propane system.

Any permanently installed stationary service container must meet American Society of Mechanical Engineers specifications. Such a container must be designed with steel supports to permit mounting the container on, and fastening the container to, concrete foundations or supports. The steel supports must be protected against fire exposure by a metal having a fire resistance rating of at least two hours.

The before-mentioned pressure/temperature sensitivity of liquified propane causes special problems in storage containers. Any variation in either of these two factors causes the volume of the liquified propane to change. A pressure relief valve (spit valve) allows excess pressure to leave the container. However,

83 National Fire Protection Association, op. cit., Section 213.
84 Interview with Mr. William Campbell, Kalamazoo, Michigan, January 16, 1982.
85 National Fire Protection Association, op. cit., Section 2143.
86 Ibid., Section 221.
the propane temperature is dependent on outside air temperature. This means that during hot summer months, the container can only be filled to 85 percent capacity. The excess 15 percent of the container leaves room for the propane to expand. On cold winter days, containers can be filled nearer the full capacity. In winter or summer, if the container pressure ever gets over the pressure required for that particular container, the pressure relief valve restores the container pressure to normal. 87

Extremely large volumes of propane gas can be stored in subterranean salt domes. The gas is pumped into a salt dome that has been flushed with water to create an open cavern. As the gas enters a dome, it displaces the water and fills the underground salt cavern. When the gas is needed, it is pumped out of the cavern, any water is removed from the gas, then the gas is transported to wherever it is needed. 88 One of these huge domes is located on the Mid American Pipeline Company main trunk in Hutchinson, Kansas. The capacity of this cavern is presently over seven million gallons and has the capability of containing nearly one billion gallons. 89 These domes rent annual contracts. Prices range from 42 cents to 52 cents per 42 gallon barrel stored. 90

87 Ibid., Section 2215.
Compliance with state and federal regulations makes handling and storage of propane very safe. New regulations, such as the National Fire Protection Association emergency shutoff valve (ESV) requirements, continually strive for further safety. All liquid propane bulk handling facilities were to have an ESV system by December 31, 1980. This system will close all tanks and lines in a plant from loading facilities. The ESV utilizes a single knife valve or a gate valve. Warren Hansen, the chief engineer of Getty Refining (Skelgas) Company predicts that, "The LP-Gas industry will enjoy an even stronger safety record now, as a result of the ESV program." 

Propane is priced to the end user according to the volume of each purchase. Storage containers with less than 13 gallons of capacity are filled according to the weight of the propane. About 100 pounds of propane will fill a 13 gallon container. The propane to fill an empty 100 pound container will cost $1.50 per gallon, plus sales tax. An empty 20 pound container (two and one half gallons) can be filled for eight dollars, plus sales tax. These twenty and 100 pound containers are shaped similar to large bottles, leading to the use of the term "bottle gas" as a slang term for propane. The minimum bulk order for propane is 200 gallons. Bulk price for propane

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92 Ibid., p. 23.
is 62.9 cents per gallon, plus sales tax. A discount of one-half cent per gallon can be taken if the invoice is paid within 15 days of purchase. Propane for use as highway motor fuel costs 72 cents per gallon, plus sales tax. 93

Demographics.

The 1980 Census revealed that 226,504,825 people (including armed forces overseas), were living in the United States. The state of Illinois had 11,418,461 residents according to the Census. 94 Estimates made by the Bureau of the Census in 1979 figured the population of the United States to be 218,059,000. 95 Approximately five percent of the 218 million people lived in Illinois; as 11,243,000 people were estimated to live there. 96 Farm population in the United States was estimated to be 8,005,000 in 1978, or only three and seven tenths of the entire population. In 1970, census takers found 473,000 Illinois farm-dwellers. 97

Gross National Product (GNP) for the United States in 1978 was $2,108 billion. 98 Comparing the GNP to the population estimate for

93 John Filessner, op. cit.
96 Ibid., p. 6.
97 Ibid., p. 681.
98 Ibid., p. 437.
1978 gives a per-capita GNP of $9,644. Illinois had a gross state product of $88,235 million during 1975. Removing all necessary state and local taxes from the percapita GSP left each individual Illinois citizen $6,059.

The Illinois GSP in 1975 included $47,762 million of personal income from 4,403,600 nonfarm employees. Illinois farm income totaled $2,376 million and government salaries were $8,211 million. In 1979 the average total wages and salaries of an Illinois working citizen was $14,337, up 75.7 percent from 1970. Total labor and proprietor's income for the United States was $1,246 billion. This income can be further delineated to $28.6 billion as agricultural income, $921 billion nonagricultural income, and $173 billion as governmental related income.

In 1976 there were 74,005,000 single and multi-family dwellings in the United States. Nonfarm dwellings totaled 71.3 million. Owner occupied nonfarm dwellings comprised 64.1 percent of the

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99 Ibid., p. 438.
101 Ibid., p. 12.
102 Ibid., p. 51.
103 Ibid., p. 12.
total and 82.1 percent of the total farm.\textsuperscript{106}

The census bureau reported in 1977 that 382,837 wholesalers were operating in the United States; 21,237 of them were in Illinois.\textsuperscript{107} There was a total of $1,258 billion in wholesale sales for the United States and $97 billion in Illinois. Illinois wholesalers employed 280,312 people and paid each $4,207,197 during 1977.\textsuperscript{108} The 21,237 Illinois wholesalers included 915 petroleum product wholesalers with $97 billion in sales. Thirty-six liquid petroleum gas wholesalers had $68 million worth of sales.\textsuperscript{109} Service-related businesses numbered 96,942 in Illinois during 1977.\textsuperscript{110} These businesses had $10.6 billion in receipts and a payroll of $3.4 billion.\textsuperscript{111} The census bureau reported that 84,988 retail stores in Illinois had total receipts of $39.2 billion in 1977. These stores employed 732,068 people.\textsuperscript{112} There were 288 liquid petroleum gas dealers operating


\textsuperscript{109} Ibid., p. 9.

\textsuperscript{110} Ibid., p. 9.

\textsuperscript{111} Ibid., p. 2.

in Illinois during 1977 with $132.8 million in sales. Fifteen
dealerships were partnerships and 64 were single proprietorships.\footnote{113}

The Department of Transportation reported that 132.5 million
motor vehicles were registered during 1975 (excluding an estimated
20,500 intercity busses). This figure includes 106.7 million passen-
erg cars and taxis; 50,811 intracity and school busses; 25.8 million
trucks; and an estimated 20,500 intercity busses.\footnote{114} Automobiles
and taxis traveled 1,028 billion miles in 1975 while the combina-
tion of trucks, school busses, and intracity busses traveled 278
billion miles. The estimated 20,500 intercity busses traveled an
estimated 1.1 billion miles.\footnote{115}

Motor gasoline consumption in the United States (including
military vehicles), totaled 2,576 million 42 gallon barrels in
1976.\footnote{116} Automobiles used 2,018 million barrels, busses 10 million,
and trucks 465 million.\footnote{117} Commercial trucks consumed 279 million
barrels of gasoline during 1976.\footnote{118} Commercial gasoline used in the

\footnote{113}{\textit{Ibid.}, p. 8.}
\footnote{114}{Department of Transportation, \textit{National Transportation
Office, 1980), p. 49.}
\footnote{115}{\textit{Ibid.}, p. 50.}
\footnote{116}{Department of Energy, \textit{End Use Energy Consumption, Data Base:
Transportation Sector, February, 1980,} (Washington, D.C.: Government
Printing Office, 1980), Table 1.2 A.}
\footnote{117}{\textit{Ibid.}, Table 1.2 B.}
\footnote{118}{\textit{Ibid.}, Table 7.1.}
state of Illinois totaled 14 million barrels. \textsuperscript{119} Diesel fuel consumption totaled 377 million barrels during 1976. \textsuperscript{120} Diesel fuel consumption includes the following types of vehicles: Busses and commercial trucks used 14 million and 228 million barrels respectively. \textsuperscript{121} Seven million barrels of liquid petroleum gas was consumed in the United States during 1976 as motor fuel. \textsuperscript{122} Commercial trucks used 6.5 million barrels of the seven million barrel total. \textsuperscript{123}

The United States liquid petroleum gas industry employs 86,000 people and a $7.5 billion capital investment. That capital investment includes the following elements: 225,000 miles of pipeline; 25,000 trucks; 22,000 rail cars; 250 major storage facilities with a seven billion gallon capacity; 8,000 bulk plants; and 25,000 retail outlets. The National Liquid Petroleum Gas Association has nearly 4,000 members from the United States and around the world. These members are from sectors of the LPG industry including production, wholesale and retail outlets, appliance and equipment manufacturers and distributors, tank and cylinder manufacturers, and transportation firms. \textsuperscript{124}

\textsuperscript{119}\textit{Ibid.}, Table 5.2 C.
\textsuperscript{120}\textit{Ibid.}, Table 1.2 A.
\textsuperscript{121}\textit{Ibid.}, Table 7.1.
\textsuperscript{122}\textit{Ibid.}, Table 1.2 A.
\textsuperscript{123}\textit{Ibid.}, Table 7.1.
Total liquid petroleum gas sales for 1979 were 18.9 billion gallons, (including LPG and ethane). The total sales figure also includes .2 billion gallons of LPG exports and 11 billion gallons of propane. Liquid petroleum gas sold in the United States was purchased by 18 million customers. Farm accounts numbered 1.5 million, or exactly one-half of the three million farms in the United States.

Consumption of liquid petroleum gas is delineated into the following six categories: residential/commercial; internal combustion; industrial; gas utility; chemical production; and miscellaneous. The industrial category includes petroleum refining and miscellaneous uses include farm and synthetic natural gas (SNG) production. The consumption for each category is listed in Table 1 for the United States and the state of Illinois, (all figures are in millions of gallons).


Table 128
Propane Consumption, 1979

<table>
<thead>
<tr>
<th>Use</th>
<th>Illinois</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential/Commercial</td>
<td>254,258</td>
<td>4,700,000</td>
</tr>
<tr>
<td>Internal Combustion</td>
<td>20,419</td>
<td>400,000</td>
</tr>
<tr>
<td>Industrial</td>
<td>W*</td>
<td>2,100,000</td>
</tr>
<tr>
<td>Gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utility</td>
<td>308,735</td>
<td>800,000</td>
</tr>
<tr>
<td>Chemical</td>
<td>576,576</td>
<td>8,200,000</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>W*</td>
<td>2,700,000</td>
</tr>
<tr>
<td>Total</td>
<td>1,711,367</td>
<td>18,900,000</td>
</tr>
<tr>
<td>(including W)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figures withheld to protect market information of easily identifiable companies.*

128 Ibid., p. 4.
Products and Services

Propane companies market and service a wide variety of products. These products are used either by the commercial, farm, industrial, or residential target markets.  

Commercial and industrial target markets employ propane fueled in-plant motor vehicles, highway motor vehicles, water heaters, water softeners, blast furnaces, and heating systems. The farm target market utilizes propane fueled grain dryers, furnaces, cooking stoves, water heaters, water softeners, and tractors. The residential target market uses camping stoves, clothes washers and dryers, cooking grills, ornamental yard lights, water heaters, water softeners, furnaces, and air conditioners.

Liquified propane is an inherently unstable substance due to the pressurization necessary to liquify the gaseous propane. Therefore, special training is needed to handle and repair equipment fueled by liquid propane. Propane companies employ a repair specialist to install and service propane fueled products. Furnace and boiler maintenance keep the repair specialist busy in the winter. Installation and maintenance of appliances, lights, and grills aid

129 Mr. Tom Lambert, Lecture at Western Michigan University, November, 1980.
the cash flow of the propane company and may require time from the repair specialist throughout the year.¹³²

Repair specialists not only service the products but also maintain and install the equipment necessary for the operation of all propane fueled products. This equipment includes the storage tank, converter, regulator, and suppressor.¹³³ The tank must meet exacting requirements listed in the National Fire Protection Association (NFPA) Pamphlet 58. These requirements include specifications stated by NFPA, the American Society of Mechanical Engineers, and the American Society for Testing and Materials.¹³⁴ The converter, which is located on top of the storage tank, converts the liquified propane to a gas. The gas pressure is then brought under control by the regulator, which is also on top of the tank. The suppressor is located on the outside of the building that the propane tank serves. The suppressor further decreases the in-line pressure before the propane enters the building.¹³⁵

Propane companies furnish storage tanks and necessary equipment to customers. The practice of furnishing tanks is advocated by the 1973 Emergency Petroleum Allocation Regulations. These laws

¹³³Lamber:, op. cit.
specify no propane company may fill the tank of another company. This also means that no customer can buy from another company and lag on outstanding bills to the original company.  

Services provided by propane companies include operating accounts on the "keep full" basis. This concept allows a company to fill the tank of a customer as the tank needs to be filled. The customer is then billed in a revolving charge account. Payments are made as the customer sees fit, and the propane company can fill the tank as the tank runs low.

A small number of propane companies also fuel highway vehicles. The vehicles these companies fuel may operate exclusively on propane or on either gasoline or propane (dual fuel). The conversion to a propane or a dual fuel system is performed by propane dealers. Prices of conversions vary from $900 to $1,200 for an automobile to approximately $800 for a pick-up truck. Conversion to a propane only system involves removal of the former gasoline system and installation of a propane tank, pressure relief valve system, fill line conversion, and propane carburetor. Installation of a dual fuel system involves the above equipment, a selector switch (change from gasoline to propane), and a vacuum fuel lock.

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136 Lambert, op. cit.
138 International Harvester Corporation, How to Reduce New Gas-Powered Truck Operating Costs, (International Harvester Corporation), (Sales Pamphlet).
139 Mort Schultz, op. cit.
Promotional Activities

Promotion is communicating information between seller and buyer to change attitudes and behavior. Propane companies utilize promotion activities to inform target customers that products are available at various places and at reasonable cost.¹⁴⁰

Four forms of promotion are available to propane companies. These forms of promotion are: advertising, personal selling, sales promotion, and publicity (Figure 4). Advertising is any paid form of nonpersonal presentation of ideas, goods, or services by an identified sponsor. Personal selling involves direct face-to-face relationships between sellers and potential customers. Sales promotion attempts to complement the advertising, personal selling, and publicity of a firm. Types of sales promotions include calendars, sample packages, free trials, point-of-purchase material, contests, coupons, and trade show displays. Publicity involves any attention attracted to the firm and offerings of that firm without having to pay any media costs.¹⁴¹ Nine vehicles are employed to convey the forms of promotion to customers. The vehicles are: billboards, direct mail, magazines, newspapers, personal selling, point-of-sale, publicity, radio, and television.¹⁴²

¹⁴¹Dr. Andrew F. Powell, Class lecture, Marketing Department, Western Michigan University, Kalamazoo, Michigan, November 18, 1980.
¹⁴²Dr. Linda M. Delene, Marketing Department, Western Michigan University, Kalamazoo, Michigan, March 30, 1982.
Promotional vehicles direct the forms of promotion used by a firm to various target markets. Propane companies direct promotional activities at the following major target markets: commercial, farm, industrial, and residential. (Figure 5.)

143 Dr. Andrew F. Powell, op. cit.
144 Mr. Tom Lambert, Lecture at Western Michigan University, November, 1980.
### Forms of Promotion and Promotional Vehicles

<table>
<thead>
<tr>
<th>Promotional Vehicles</th>
<th>Advertising</th>
<th>Personal Selling</th>
<th>Sales Promotion</th>
<th>Publicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billboards</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Direct Mail</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Magazines</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Newspapers</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Personal Selling</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point-of-Sale</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publicity</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Radio</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Television</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Figure 5
Promotion by Target Market

<table>
<thead>
<tr>
<th>Forms of Promotion</th>
<th>Commercial</th>
<th>Farm</th>
<th>Industrial</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertising</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Personal Selling</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sales Promotion</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Publicity</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Benefits of This Study

The benefits of this study to propane consumers are as follows:

1. A benefit of this study to propane consumers is to determine propane price structure.\(^{145}\)

2. A benefit of this study to propane consumers is to locate firms that perform vehicle fuel conversions.\(^{146}\)

3. A benefit of this study to propane consumers is to determine availability of propane appliances.\(^{147}\)

4. A benefit of this study to propane consumers is to illustrate modifications necessary to perform a fuel conversion.\(^{148}\)

The benefits of this study to petroleum jobbers are as follows:

1. A benefit of this study to petroleum jobbers is to provide clarification that the current Illinois propane market is unstable due to agricultural dependency.\(^{149}\)

2. A benefit of this study to petroleum jobbers is to determine the status of propane when petroleum allocation and price

\(^{145}\)Consumer A, Interview at Kalamazoo, Michigan, January 25, 1981.

\(^{146}\)Consumer B, Interview at Kalamazoo, Michigan, January 26, 1981.

\(^{147}\)Consumer C, Interview at Kalamazoo, Michigan, January 26, 1981.

\(^{148}\)Consumer B, Interview at Kalamazoo, Michigan, January 26, 1981.

\(^{149}\)Jobber A, Interview, January 26, 1981.
controls are removed.\textsuperscript{150}

3. A benefit of this study to petroleum jobbers is to determine the feasibility of the addition of propane to the marketing mix of a jobbership, in order to enhance the profitability of the jobbership.\textsuperscript{151}

4. A benefit of this study to petroleum jobbers is to identify the volume of propane used for home heating in Illinois.\textsuperscript{152}

\textsuperscript{150} Jobber B, Interview, January 26, 1981.

\textsuperscript{151} Jobber C, Interview, January 26, 1981.

\textsuperscript{152} Jobber D, Interview, January 27, 1981.
INFORMAL INVESTIGATION

The informal investigation sources for this study, Identification of the Attitudes of Illinois Petroleum Jobbers About the Marketing of L-P Gas, were contacted by personal and telephone interviews. The informal investigation sources for this study are as follows:

1. An informal investigation source for this study is a personal interview with Mr. Larry Williams, a Western Michigan University petroleum instructor.

2. An informal investigation source for this study is a personal interview with a Detroit area petroleum jobber.

3. An informal investigation source for this study is a telephone interview with a Kalamazoo jobber apprentice.

4. An informal investigation source for this study is a telephone interview with an Illinois petroleum jobber.

5. An informal investigation source for this study is a telephone interview with a partner in an Illinois petroleum and L-P Gas jobbership.
INTERVIEW WITH A PETROLEUM INSTRUCTOR

Interviewer: Please describe the physical characteristics of propane.

Interviewee: It is a liquid petroleum gas that comes off the top of the refining process. It is one of the light ends at the top of fractional distillation. "Propane's" got a dual characteristic of... is it boiling? Whatever it is, it's at $-45^\circ F$. It is liquified for transportation and storage. Then it is changed to a gas for use... The gas/liquid change takes place constantly.

Interviewer: So it is unstable?

Interviewee: Well, yes. It changes from gas to liquid to gas, and that's not too stable to me.

Interviewer: Describe the current position of propane in the composite petroleum market.

Interviewee: Well, it's a by-product.... However, with price controls just "goin" off, well, it's hard to tell "what'll" happen this afternoon. I guess it's limited to small rural communities for heating and cooking. When natural gas arrives the propane is replaced with it. Then that just leaves the farms. I think..... this is a prediction, that it will command a higher price now. "Propane will" catch up with fuel oil in price. But, "it'll" still replace fuel oil for heat because it's easier to convert from propane to natural gas.

Interviewer: Could you describe any local commercial firms that are using propane as a motor fuel?

Interviewee: I don't know of any.

Interviewer: Please describe any potential propane has as a motor fuel.

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153 Interview with Larry Williams, a petroleum instructor, Kalamazoo, Michigan 49008, January 3, 1981.
Interviewee: Well, it has to be under pressure.....I guess that makes it a hazard. If a hose bursts or something like that happens it could cause real problems. Then too, "there's" not that much product available.....to sell. "Let's" face it, propane "can't" have an expanding market. If you move to motor fuel, some other area has to give up the propane.....heating, cooking.

Interviewer: Describe how the current market position of propane will change in the next five years.

Interviewee: "Propane will" still be a by-product of natural gas and refining. The market will be determined by how much refineries choose to produce. "Let's" face it, propane is not a big thing to a refinery. "Nobody's" out inventing up new and exciting ways to get more propane out of a barrel of crude oil. On the other hand, they're using propane to get more gasoline.

Interviewer: Could you describe an example?

Interviewee: Well.....uh.....I've got an ad right here, if I can find it. Ok, right here. Ashland has a new gasoline process at the expense of light ends (which includes propane) and heavy oils (which includes fuel oils, residuals, and lube oil feedstocks). That stuff is refined using a new process to build up the light ends and break down the heavy oils. This results in more hydrocarbons suited to gasoline per barrel of crude. See here, over 34 gallons now versus only 27 before. That's really "going" to hurt propane if the process is widely accepted.

Interviewer: So, propane's future isn't too good?

Interviewee: LPG's market is too supply oriented. "Let's" face it, propane dealers are there to get rid of a by-product. Then comes the option of "making" a buck, if they can, too. They just sell whatever the refiner gives them.

Interviewer: The future of propane is tied to refining in a very dependent way.

Interviewee: That's right. "It'll" depend on gasoline.
Right now refineries are runnin' at 73 percent capacity. That means less LPG. It's geared to the supply and demand for other products. Like now, fuel oil is "getting" short in some places because we've got gasoline "running" out of everyone's ears. The whole ball of wax is tied to gasoline or refinery runs specifically geared to fuel oil.
INTERVIEW WITH A PARTNER IN A GASOLINE/PROPANE JOBBERSHIP

Interviewer: How long have you been in the propane business?

Interviewee: Well, uh....Dad started in 1950....1956-about 25 years.

Interviewer: Are you a branded dealer or an independent?

Interviewee: We're branded major. A national company.

Interviewer: Describe the current position of propane in relation to the entire petroleum market.

Interviewee: Well, uh.....it's just like everything else lately. The price increases are forcing conservation in industry, homes, small firms. They just can't afford to burn it.

Interviewer: How do you think decontrol will affect propane?

Interviewee: I don't know for sure....It should be beneficial. Uh, fuel oil, gas, electricity, all should increase in price. That'll make propane more competitive per BTU. Now it isn't too competitive with fuel oil and electricity per BTU. As natural gas goes up, maybe we'll be more competitive with it.....In two years, maybe we'll compete. But, uh, the price increases on everything'll keep "going" for a year or two. Fuel oil's "bein" hurt now, bad. They may have to put a hold on it to keep it competitive.

Interviewer: Describe any local firms that are using propane as motor fuel.

Interviewee: We've got some outfits on it, not highway though. They're "usin" it in in-plant fork-lift trucks. It's great for them because there are...
so fewer emissions an' it lengthens engine life an' needs less maintenance. Some individuals are usin' it, NO FLEETS (Sic). We're not pushin it, not performing conversions. One of our competitors is performing conversions on motor vehicles, but not us.

Interviewer: So you are not advocating its use as a motor fuel.

Interviewee: It's good in instances where you've got a mechanically inclined company. You know, they've got a good mechanic that'll do good maintenance work. But, fueling is the drawback. They've gotta have a place for a tank an' have somebody trained to do the fueling. We've got six to eight customers usin' it in cars an' pick-ups. But they come here an' we fuel 'em off our truck. We also service 50-60 plant fork-lift trucks.

Interviewer: Do you operate any propane vehicles?

Interviewee: Yes. We run a single propane bulk truck. It runs right outta the bulk tank. We figure the motor fuel tax by a miles driven to miles per gallon ratio.

Interviewer: Is that common practice for propane trucks?

Interviewee: Yes, it is, if you're runnin' propane. Some run gasoline or diesel fuel. I dunno if you'd be interested, but one of our employees runs a car on propane. He really likes it. This is his third car too, I think. No, I know this is his third car.

Interviewer: Are there any other propane companies in your area?

Interviewee: Let's see, there's about five others in 25 miles. That's besides us.

Interviewer: Describe how the current market position of propane will change in the next five years.

Interviewee: I don't see any really big changes, other than decontrol. It'll still be a supply oriented market. But, a lotta our propane comes from petrochemical plants, as a by-product. They're gettin' a little more
propane from those plants now than before. In fact, I believe about 50 percent of our propane from our supplier is from petrochemical plants. If they increase that some, we may be able to expand some. I don't know the percent of retail propane that is from petrochemicals, but if that output expands, we may be able to increase our market.
INTERVIEW WITH A JOBBER APPRENTICE

Interviewer: How long have you been in the oil business?

Interviewee: Let's see, I've been in three at what I'm doing right now. Before that I was in a service station for a long time.

Interviewer: Please describe the physical characteristics of propane.

Interviewee: Hum...it's a gas at the well. Then it's compressed into a liquid. That makes it easier to transport and store. You sell it by the pound in little cylinders or by the gallon in bulk tanks.

Interviewer: So the propane is always compressed?

Interviewee: Well, no. The pressure is removed for consumption. That way it's like natural gas. The gas vapor is easier to burn and more efficient burning (Sic).

Interviewer: Describe the current position of propane in relation to the composite petroleum market.

Interviewee: The way I see it, propane's takin' over the fuel oil market. It's cheaper to install a propane furnace than fuel oil. Then too....it is an interim fuel for natural gas. People can put in a propane furnace and convert to natural gas a lot cheaper than they could convert from fuel oil. Oh, I see it as primarily rural, too, since natural gas lines aren't there.

Interviewer: What do you think decontrol is going to do to the fuel oil/propane picture?

Interviewee: Who knows? I'm good at hindsight. I just know that building contractors aren't building houses with fuel oil furnaces now. That probably'll cut fuel back even more.

Interview with a jobber apprentice, Kalamazoo, Michigan area, February 4, 1981.
Interviewer: Are those new homes urban?

Interviewee: We deal mostly with rural locations. Natural gas is available everywhere there are enough houses to run a pipe.

Interviewer: Describe any commercial firms that are using propane as a motor fuel.

Interviewee: OK....Huh, a propane dealer here in town uses it to run his trucks. Other than that I really couldn't tell you. One farmer uses it in tractors and his pick-up. We don't sell any, so I don't know of any others.

Interviewer: Describe any potential propane has as a motor fuel.

Interviewee: Well, based on what I've read, it has good possibilities. It is more efficient than gasoline. It has less maintenance than gasoline, too. Uh, I've never really compared diesel. But, I'd think diesel would be best for heavy duty trucks. For delivery vans, pick-ups, I think it'd be O.K. Cars, you could maybe use it in.

Interviewer: So, the use depends upon the application?

Interviewee: That's right. Analyze the engine, vehicle life, maintenance, and cost per mile. That's the way I'd do it.

Interviewer: Please describe how the current market position of propane will change in the next five years.

Interviewee: Uh.....this is a guess. This decontrol of natural gas before the originally scheduled 1985 date will really shake things up. Since the big oil companies own rights to gas too, the prices of propane, natural gas, and fuel oil will all be nearly the same--this is a GUESS (Sic).

Interviewer: If this happens--the prices being relatively equal--will anyone convert back to fuel oil from propane since it is more BTU efficient?

Interviewee: Well, in spite of the cost efficiency, I don't think so. Nobody is going to switch propane to fuel oil.
Interviewer: Could that price parity cause more new installations of fuel oil?

Interviewee: New installations won't move unless natural gas won't go there, since it's too rural. The propane will stay as an interim wherever there is even a slim chance that a natural gas pipe will be near by. About the only way fuel oil'll be put in is if the owner has preference to it.

Interviewer: Has there been a noticeable trend toward propane in the rural market?

Interviewee: Yes. We have lost a lotta fuel oil customers. They were mostly stuck with oil furnaces, 20-30 years old. Since it costs less to install a propane furnace, maintain it, and, right now, run one, why put in oil?

Interviewer: Describe any ideas your company has about entering the propane market.

Interviewee: Well, four years ago, our owner had a chance to buy the local propane operation. He didn't and somebody else did. The guy's been kicking himself in the (expletive) for not doin' it ever since. The problem is it's so capital intensive. A bulk storage tank for a house costs $500. Plus a delivery truck, plant storage, insurance. It'd need one heck of a payback. But if it had the payback potential, I think we'd lick the capital problem one way or another.

Interviewer: So you'd need an extremely good return?

Interviewee: That's right. That's the only way.
INTerview with a Jobber

Interviewer: How long have you and your company been in business?

Interviewee: I guess the company over 31 years. I've been in eight years.

Interviewer: Please describe the physical characteristics of propane.

Interviewee: Propane is a gas... which is transported under pressure by pipeline and truck. It has an odor added so you can tell that it's propane, to identify it. It's a highly flammable product.

Interviewer: So it is pressurized all the time?

Interviewee: Yeah. It is.

Interviewer: Describe the current position of propane in relation to the composite petroleum market.

Interviewee: Today propane is used basically as a 'bottle gas'. The applications are home heating and cooking. It is also used in high-lows and some types of vehicles as a motor fuel. Uh... it's a go-between for fuel oil and natural gas.

Interviewer: Would you please explain what you meant by 'bottle gas'?

Interviewee: It's in big bottles when shipped and stored.

Interviewer: How does propane act as the "go-between for fuel oil and natural gas"?

Interviewee: Right now fuel oil and natural gas are the two main fuels used for heat. The propane is used between the two. A person can convert his furnace from fuel oil to propane.

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156 Interview with a Detroit area jobber, Kalamazoo, Michigan, February 6, 1981.
Then, when natural gas is available, he can hook up to the natural gas with less expense.

Interviewer: Describe any local commercial firms that are using propane as a motor fuel.

Interviewee: The ones in our area are basically high-lows.

Interviewer: No use in over-the-road?

Interviewee: Nope, just as an in-plant fuel. Not over-the-road, that I know of.

Interviewer: Describe any potential propane has as a commercial motor fuel.

Interviewee: From what I've read, propane gets better mileage than gasoline. Uh, it's cleaner burning. It's a lot cleaner burning than gasoline in the engine and emissions wise. The big drawback is that it's not readily available; you can't get it at any gas station. It has definite potential if the price of gasoline keeps on going up because it's bad enough now.

Interviewer: You think that gasoline's price will increase more than propane's price.

Interviewee: Not really so much. Uh, they're both products of petroleum......They've got a common beginning. Too much propane is being flared off now. Like down in Mexico, they're flaring off lots and lots of propane there. Enough demand is not present to warrant moving it up here. But, they've got lots of propane. So, to me, there's a huge untapped source of propane. If that's ever turned loose on the market, the price would have to go down.

Interviewer: Where is the demand to come from?

Interviewee: The demand's gonna come at the commercial level, first. As the public becomes aware, there will be demand then. But the public must be told it's there. The hinge is the public demand. They can't buy something they don't know is there. That knowledge should increase demand and lead to more extensive distribution. If the stuff is made convenient to the public, they'll buy it.
Interviewer: Describe how the current market position of propane will change in the next five years.

Interviewee: The supply is there. As the price of other fuels goes up, propane demand should increase. The demand for propane for motor fuel will cause more production of propane. Auto makers should begin building propane engines, too. That's because they have to meet mileage requirements. They haven't even met the 1977 standards, as far as I know. The increase in mileage propane gives should make the auto companies look at propane engines real hard.

Interviewer: So propane's use as a motor fuel will increase?

Interviewee: Definitely.

Interviewer: Why?

Interviewee: Propane's gonna move up because of the need for fuel efficiency improvement. The demand should increase as the commercial firms increase use. They'll use it because it will be cheaper to operate than gasoline. With decontrol of propane, the price is bound to go up. But, the price will seek its own level, and it'll be cheaper than gasoline, I think. The price will be set within the U. S. exclusive of the world market.

Interviewer: If the demand for propane as a motor fuel were high, would you get in the propane business?

Interviewee: Definitely. We'd put it in our company operated stations. Our business is selling petroleum products for motor vehicles. So, we'd have to be in it, wouldn't we?
INTERVIEW WITH A JOBBER

Interviewer: How long have you been out of the propane business?

Interviewee: Hum....Dad got out in '63. Yeah, it was 1963 because I was a senior in high school.

Interviewer: Why did he get out of propane?

Interviewee: Dad got into the propane business in the late fifties. At that time people around here were replacing old, worn-out coal furnaces. By adding propane to the company Dad gave an alternative to customers. Many went with propane for various reasons, like fuel oil's smell. It was a good move at that time. It provided the company with cash flow and a potential for growth. Then, in 1963 the gas company laid a pipeline out here. Everyone here in town with propane heat hooked up to the gas lines. Since this is such a small town, the propane and fuel oil businesses were hurt real bad. Dad felt that the investment in propane equipment was just too great to weather the storm, so to speak.

Interviewer: Under what conditions would your dad have stayed in the propane business?

Interviewee: Maybe if he had gotten started, oh say four years earlier he'd have been big enough. That's big enough capital wise. Uh, he just couldn't compete with natural gas 'cause he was too small.

Interviewer: Please describe the physical characteristics of propane.

Interviewee: I can't do too good a job. But, uh....it's a liquid that's under pressure. There's an odor added, an' it's really heavy, too.

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Interview with a jobber, Illinois, February 6, 1981.
Interviewer: Describe the current position of propane in relation to the composite petroleum market.

Interviewee: I can't. I just don't know enough about it.

Interviewer: Describe any local commercial firms that are using propane as a motor fuel.

Interviewee: There's two that I know of. Both of our propane companies use it.

Interviewer: Describe any potential propane has as a motor fuel?

Interviewee: Well, the big point seems to be it's such a clean fuel. It lengthens engine life 'cause it doesn't put all the crud in an engine that liquid fuel does. I don't know a thing about cost, BTU, or octane comparisons between propane and liquid fuels.

Interviewer: Describe any recent changes you have noticed in the fuel oil/propane relationship.

Interviewee: Hum....there's not a lot to say. Propane is still big in the rural market for grain dryin' and cookin'. There's less use of fuel oil for heating', that's rural and town customers both. The reason is simple, too, it's just too expensive.

Interviewer: Please describe how the current market position of propane will change in the next five years.

Interviewee: I think, perhaps, that, over a short time the fuel oil price will rise real fast and go real high. The price differential between propane and fuel oil will level out just where it is right now. It's just that the price of liquid fuels are goin' wild. The gas fuels are bound to go up someday, too. Propane has always had a better margin of profit than gasoline and fuel oil. That's what has made it attractive to people over the years. The high margin is gonna hold on, I'm sure it will, too.

Interviewer: What effects will decontrol have on propane and gasoline.
Interviewee: I'm not sure, really. I don't know much about decontrol on anything. But, I'd guess everything will be priced a lot higher. That goes for propane, gasoline, fuel oil, and electricity. I think the higher prices are gonna force some evaluations by energy consumers. The higher prices may bring about increased use of new fuels and/or old fuels. These fuels may be more easier or economical than our present primary fuels. For instance, we've got a power plant near here that's gas fired. If the gas gets too high they'll probably, or at least should, start usin' coal. I mean, it's only 40 miles to enough coal to light the whole state for years.

Interviewer: Do you think you'd ever get back into the propane business?

Interviewee: You know, I think we've come a complete circle. In '63 the local market for propane was really in bad shape. But now, I think the increases in the number of grain dryers and the price of natural gas could create quite a market. Especially if gas prices get high enough so that a small company could compete with it. Given a chance, I think we could swing it, and would.
SCOPE

The scope of this study, Identification of the Attitudes of Illinois Petroleum Jobbers About the Marketing of Propane, focuses on the petroleum jobbers serving Illinois. Members of the Illinois Petroleum Marketers Association were selected for use in this study.

Members of the Illinois Petroleum Marketers Association sell petroleum products at the retail and wholesale levels in the state of Illinois. (See Figure 6.) Illinois is a north central state bordered on the north by Wisconsin, Iowa and Missouri border Illinois to the west. The eastern border of Illinois faces Indiana and Kentucky. Illinois is divided into 102 counties. The greatest population densities of the state are located in the northeastern area around Chicago and in the southwest around St. Louis.

There are 1,100 members of the Illinois Petroleum Marketers Association. Members are divided into the following seven categories: active, allied, fuel oil jobbers, associate, affiliate, truck stop, and inactive associate.


FIGURE 6
Map of Illinois

METHOD OF COLLECTING PRIMARY DATA

The method of collecting primary data for this study, Identification of the Attitudes of Illinois Petroleum Jobbers About the Marketing of Propane, is the survey method. The technique used to conduct the survey is the personal interview.

The advantages of the survey method for this study are:

1. An advantage of the survey method is that the survey method is the most extensively employed mode of collecting primary data.

2. An advantage of the survey method is that the survey method insures a superior degree of cooperation.

The disadvantages of the survey method for this study are:

1. A disadvantage of the survey method is that the survey method is time exhaustive and expensive.

2. A disadvantage of the survey method is that the survey method results are often not objective.

3. A disadvantage of the survey method is that the questions used in the survey are difficult to develop.

Class lecture of Dr. Jack T. Humbert, Department of Distributive Education, Western Michigan University, Kalamazoo, Michigan, February 6, 1981.
The advantages of the personal interview technique for this study are:

1. An advantage of the personal interview technique is that the personal interview allows flexibility.

2. An advantage of the personal interview technique is that the personal interview allows gathering of additional information about the study.

3. An advantage of the personal interview technique is that the personal interview encourages cooperation of the respondent.

4. An advantage of the personal interview technique is that the personal interview assists in gathering of outside information.

5. An advantage of the personal interview technique is that the personal interview allows employment of visuals to aid in respondent clarification of questions.

The disadvantages of the personal interview technique for this study are:

1. A disadvantage of the personal interview technique is that the personal interview involves costly travel.

2. A disadvantage of the personal interview technique is that the personal interview involves time consuming travel.

3. A disadvantage of the personal interview technique is that the personal interview promotes bias.
4. A disadvantage of the personal interview technique is that the personal interview encourages error.
The two types of sampling methods are probability and nonprobability. The probability method involves a universe whose members are listed and each member has an equal chance of being surveyed. The nonprobability method involves a universe whose members have an unequal chance of being surveyed.

The nonprobability convenience sampling technique is the sampling technique used for this study. The advantages of the nonprobability sampling technique are:

1. An advantage of the convenience technique is that the convenience technique is convenient for the researcher.
2. An advantage of the convenience technique is that the convenience technique is not time consuming.
3. An advantage of the convenience technique is that the convenience technique is not expensive.

The disadvantages of the convenience technique for this study are:

1. A disadvantage of the convenience technique is that the convenience technique results are biased.
2. A disadvantage of the convenience technique is that the convenience technique provides incomplete information.

162 Dr. Jack Humbert, Class lecture, Department of Distributive Education, Western Michigan University, Kalamazoo, Michigan, February 11, 1981.
Results for Question 1

1. What is your job title?

   The job titles given in response to question 1 are as follows:

   Twenty-five responded as: "President".
   Sixteen responded as: "Owner".
   Seven responded as: "Vice-president in charge of operations".
   Six responded as: "Sales representative".
   Five each responded as: "Vice-president" and "Operations manager".
   Four each responded as: "Owner-operator", "Chairman of the board", "Sales manager", and "Operations supervisor".
   Three each responded as: "General supervisor" and "Assistant manager".
   Two each responded as: "Office manager", "Secretary", "Manager", and "Plant manager".
   One each responded as: "Secretary-treasurer", "Maintenance supervisor", "Supervisor", "Vice-president of re-rail operations", "Dispatcher", and "Treasurer".

*Please refer to Appendix B for the questionnaire utilized in this study.
Results for Question 2

2. How long have you been in the petroleum business?

(A) 0-5 Years  (B) 5-10 Years  (C) Over 10 Years

TABLE 1

<table>
<thead>
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<th>Years in the Petroleum Business</th>
<th>0-5 Years</th>
<th>5-10 Years</th>
<th>Over 10 Years</th>
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<td>8</td>
<td>22</td>
<td>70</td>
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Of the respondents questioned, eight or eight percent have been in the petroleum business 0-5 years. Twenty-two, or 22 percent have been in the petroleum business 5-10 years. Seventy, or 70 percent have been in the petroleum business over 10 years.
Results for Question 3

3. Indicate by no. 1 the product your company sells in the greatest volume to no. 4 for the least volume. (If a product DOES NOT APPLY, leave it blank!!)

(A) Gasoline  (C) Diesel Fuel
(B) Heating Oil  (D) Other, please specify

TABLE 2A

Gasoline Volume

Of the respondents questioned, 92, or 92 percent indicated gasoline as the product they sell in the greatest volume. Eight, or eight percent indicated gasoline as the product they sell in the second greatest volume. A zero percentage indicated gasoline as the product they sell in the third or fourth greatest volume.
Of the respondents questioned, a zero percentage indicated heating oil as the product they sell in the greatest volume. Twenty-three, or 23 percent indicated heating oil as the product they sell in the second greatest volume. Seventy-seven, or 77 percent indicated heating oil as the product they sell in the third greatest volume. A zero percentage indicated heating oil as the product they sell in the fourth greatest volume.
Results for Question 3 (Cont'd)

TABLE 2C

Diesel Fuel Volume

Of the respondents questioned, eight or eight percent indicated diesel fuel as the product they sell in the greatest volume. Sixty-nine, or 69 percent indicated diesel fuel as the product they sell in the second greatest volume. Twenty-three, or 23 percent indicated diesel fuel as the product they sell in the third greatest volume. A zero percentage indicated diesel fuel as the product they sell in the fourth greatest volume.
Of the respondents questioned, 38 or 38 percent indicated that they sell no "Other" products. Sixty-two, or 62 percent indicated "Other" products as the product they sell in the fourth greatest volume. "Other" responses specified included automotive motor oils, automotive greases, tires, batteries, accessories, filters, industrial lubricants, and gasohol.
Results for Question 4

4. Which customer categories does your company serve?

(A) Wholesale-Commercial  (D) Urban Home Heating
(B) Farm  (E) Rural Home Heating
(C) Retail Gasoline  (F) Other, please specify

TABLE 3
Customers of Your Company

Of the respondents questioned, 92 or 92 percent serve wholesale-commercial customers. Seventy-seven, or 77 percent serve farm customers. Ninety-two, or 92 percent serve retail customers. Seventy-seven, or 77 percent serve urban home
heating customers. Ninety-two, or 92 percent serve rural home heating customers. Twenty-three, or 23 percent serve other types of customers.

Other types of customers indicated are:

- Local government.
- State government.
- Federal government.
- Other jobbers.
Results for Question 5

5. What was your company’s total gallonage (except lubricants) during 1980?

(A) 0-2 Million Gallons   (D) 10.1-20 Million Gallons
(B) 2.1-5 Million Gallons  (E) 20.1-40 Million Gallons
(C) 5.1-10 Million Gallons   (F) Over 40 Million Gallons

TABLE 4
Your Company’s Gallonage

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<td>(A) 0-2 M. Gals</td>
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<tr>
<td>(B) 2.1-5 M. Gals</td>
<td>40%</td>
</tr>
<tr>
<td>(C) 5.1-10 M. Gals</td>
<td>38%</td>
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<tr>
<td>(D) 10.1-20 M. Gals</td>
<td>15%</td>
</tr>
<tr>
<td>(E) 20.1-40 M. Gals</td>
<td>0%</td>
</tr>
<tr>
<td>(F) Over 40 M. Gals</td>
<td>7%</td>
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</table>

Of the respondents questioned, a zero percentage indicated a gallonage of 0-2 million gallons. Forty, or 40 percent indicated a gallonage of 2.1-5 million gallons. Thirty-eight, or 38 percent indicated a gallonage of 5.1-10 million gallons. Fifteen, or 15 percent indicated a gallon-
Results for Question 5 (Cont'd)

age of 10.1-20 million gallons. A zero percentage indicated a gallonage of 20.1-40 million gallons. Seven, or seven percent indicated a gallonage of over 40 million gallons.
Results for Question 6

6. Does your company sell LP-Gas?
   (A) No
   (B) Yes

TABLE 5
Presently Sell LP-Gas

Of the respondents questioned, seven or seven percent sell LP-Gas. Ninety-three, 93 percent do not sell LP-Gas.
Results for Question 7

7. The following are characteristics of LP-Gas engines. Indicate by no. 1 what YOU FEEL the most important characteristic is to Consumers, to no. 3 for the least important.

(A) LP-Gas exhaust emissions do not contribute to air pollution.

(B) LP-Gas's clean burning characteristics decrease engine wear.

(C) LP-Gas costs less per gallon than gasoline.

TABLE 6A

Exhaust Emissions

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<th>Second</th>
<th>Third</th>
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<td>0</td>
<td>0</td>
<td>80</td>
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Of the respondents questioned, a zero percentage indicated that, "LP-Gas exhaust emissions do not contribute to air pollution," is the most important or second most important characteristic of LP-Gas to consumers. Eighty, or 80 percent indicated that, "LP-Gas exhaust emissions do not
Results for Question 7 (Cont'd)

contribute to air pollution," is the third most important characteristic of LP-Gas to consumers. Twenty, or 20 percent did not respond.
Results for Question 7 (Cont'd)

TABLE 6B

Clean Burning

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<th></th>
<th>First</th>
<th>Second</th>
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<tr>
<td>100</td>
<td>23</td>
<td>57</td>
<td>0</td>
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Of the respondents questioned, 23 or 23 percent indicated that, "LP-Gas's clean burning characteristics decrease engine wear," is the most important characteristic of LP-Gas to consumers. Fifty-seven, or 57 percent indicated that, "LP-Gas's clean burning characteristics decrease engine wear," is the second most important characteristic of LP-Gas to consumers. A zero percentage indicated that, "LP-Gas's clean burning characteristics decrease engine wear," is the third most important characteristic of LP-Gas to consumers. Twenty, or 20 percent did not respond.
Results for Question 7 (Cont'd)

TABLE 6C

Costs Less Than Gasoline

Of the respondents questioned, 57 or 57 percent indicated that "LP-Gas costs less per gallon that gasoline," is the most important characteristic of LP-Gas to consumers. Twenty-three, or 23 percent indicated that "LP-Gas costs less per gallon than gasoline," is the second most important characteristic of LP-Gas to consumers. A zero percentage indicated that "LP-Gas costs less per gallon than gasoline," is the third most important characteristic of LP-Gas to consumers. Twenty, or 20 percent did not respond.
Results for Question 8

8. In your opinion, LP-Gas's future as a motor fuel is:

(A) Good  (C) Poor
(B) Fair  (D) Don't Know

TABLE 7

Motor Fuel Future

Of the respondents questioned, seven or seven percent believe LP-Gas has a "good" future as a motor fuel. Twenty-three, or 23 percent believe LP-Gas has a "fair" future as a motor fuel. Thirty-eight, or 38 percent believe LP-Gas has a "poor" future as a motor fuel. Twenty-six, or 26 percent "don't know" about the future of LP-Gas as a motor fuel. Six, or six percent did not respond.
Results for Question 8A

8. A. Please list any strong points that YOU FEEL are characteristic of propane engines.

The strong points of propane engines indicated are as follows:

Thirty-five indicated "Don't know", or did not respond.

Twenty-six indicated "Clean burning".

Twelve indicated "Less maintenance".

Eight indicated "Costs less than gasoline".

Seven indicated "Less air pollution", or "Dosen't smell".

Six indicated "Burns well", or "Burns thoroughly".

Five indicated "Longer motor oil life".

Four indicated "Longer engine life" and "Longer spark plug life".

Two each indicated "Novelty" and "Good supply".

One each indicated "Less noise", "Runs smoothly", and "Possible conversion from a gasoline engine is feasible".
Results for Question 8B

8. B. Please list any weak points that YOU FEEL are characteristic of propane engines.

The weak points of propane engines indicated are as follows:

Twenty-seven indicated "Don't know", or did not respond.

Twenty-six indicated "Availability".

Eleven each indicated "Lacks power" or "Hazardous substance".

Ten indicated "Lack of mechanic training".

Seven indicated "Hard starting".

Six each indicated "Cost of conversion" or "Weight".

Five each indicated "Lack of public acceptance" or "Need of special equipment to handle it".

Two each indicated "Cost of conversion" or "Hard to work on".

One each indicated "Lack of acceptance of auto companies", "Hard on valves", and "Increases maintenance".
Results for Question 9

9. My company's fuel oil sales are:

(A) Decreasing  (C) Increasing
(B) Unchanged  (D) Does not Apply

TABLE 8

Heating Oil Trends

Of the respondents questioned, 85 or 85 percent indicated that heating oil sales are decreasing. Eight, or eight percent indicated that heating oil sales are unchanged. A zero percentage indicated that heating oil sales are increasing or does not apply. Seven, or seven percent did not respond.
Results for Question 10

10. My company's heating oil sales are decreasing because of conversions to: (X ALL that apply)

(A) Natural Gas  (C) LP-Gas
(B) Coal  (D) Other, please specify

TABLE 9

<table>
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<td>Coal 77</td>
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<tr>
<td>LP-Gas 47</td>
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<td>Other 9</td>
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Of the respondents questioned, 77, or 77 percent indicated that, "heating oil sales are decreasing because of conversions to," natural gas. Fifteen, or 15 percent indicated that, "heating oil sales are decreasing because of conversions to," coal. Forty-seven, or 47 percent indicated that, "heating oil sales are decreasing because of conversions to," LP-Gas. Nine, or nine percent indicated that, "heating oil sales are decreasing because of conversions to," other types of fuel. The nine respondents specified "wood" as the other fuel.
Results for Question 10
(Cont'd)

TABLE 10
Natural Gas Conversions

| Less Expensive to Install | 77 | Less Expensive to Operate | 41 | Less Expensive to Maintain | 31 | Other | 1 |

Of the 77 respondents that indicated natural gas conversions are decreasing their company's heating oil sales, 41 or 41 percent indicated that less expensive installation was a reason for the conversions. Seventy-seven, or 77 percent indicated that less expensive operation was a reason for the conversions. Thirty-one, or 31 percent indicated that less maintenance was a reason for the conversions. One, or one percent indicated an "other" reason for the conversions. The "other" reason specified was "cleaner burning".
Results for Question 10  
(Cont’d)

TABLE 11
Coal Conversions

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<td>15</td>
<td>0</td>
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Of the 15 respondents that indicated coal conversions are decreasing their company's heating oil sales, a zero percentage indicated that less expensive installation was a reason for the conversions. Fifteen, or 15 percent indicated that less expensive operation was a reason for the conversions. A zero percentage indicated that neither less maintenance nor other reasons were reasons for the conversions.
Results for Question 10
(Cont'd)

TABLE 12

LP-Gas Conversions

Of the 47 respondents that indicated LP-Gas conversions are decreasing their company's heating oil sales, 15 or 15 percent indicated that less expensive installation was a reason for the conversions. Forty-seven, or 47 percent indicated that less expensive operation was a reason for the conversions. Fifteen, or 15 percent indicated that less maintenance was a reason for the conversions. A zero percentage indicated other reasons.
Results for Question 10  
(Cont’d)

TABLE 13
Other Conversions

Of the respondents questioned, nine or nine percent indicated that "other" types of conversions are decreasing their company's heating oil sales. A zero percentage indicated that less expensive installation was a reason for the conversions. Nine, or nine percent indicated that less expensive operation was a reason for the conversions. A zero percentage indicated that less maintenance or "other" reasons were reasons for the conversions. The nine respondents specified wood as the "other" type of conversion.
Results for Question 11

11. In your opinion, heating oil customers convert to LP-Gas because of future availability of natural gas:
   (A) Often
   (B) Seldom
   (C) Never
   (D) Don't Know

TABLE 14
LP-Gas Heating Conversions Depend on Natural Gas

Of the respondents questioned, 31 or 31 percent feel LP-Gas conversions often depend on availability of natural gas. Eight, or eight percent feel LP-Gas conversions seldom depend on availability of natural gas. Twenty-three, or 23 percent feel LP-Gas conversions never depend on availability of natural gas. Thirty-eight, or 38 percent did not know
Results for Question 11
(Cont'd)

of did not answer about LP-Gas conversions depending on the availability of natural gas.
Results for Question 12

12. The recent lifting of petroleum allocation regulations has prompted many companies to expand or contract their product lines. Your company's plans are:

(A) Expand to include Coal
(B) Expand to include LP-Gas
(C) Withdraw From the Heating Oil Business
(D) Other, please Specify

TABLE 15

Future Plans

Of the respondents questioned, a zero percentage indicated that they will expand their product line to include coal. Seven, or seven percent indicated that they will expand their product line to include LP-Gas.
Results for Question 12
(Cont'd)

Twenty-three, or 23 percent will withdraw from the heating oil business. Sixty-nine, or 69 percent indicated "Other" responses.

The "Other" responses indicated are as follows:

Twenty-four indicated "Don't know", or "Undecided", or did not respond.

Seven each indicated "Expand wherever we can", or "Expand retail operations".

Six each indicated "Expand self-service operations" or "Expand lubricants sales".

Five indicated "Hold our own" or "Maintain current volume".

Four each indicated "Expand convenience store operations", "Build convenience stores", "Get out of TBA (tires, batteries, and accessories)", or "Sell the bulk plant".

Two each indicated "Cease tankwagon operations", "Sell the warehouse", "Diversify into non-energy fields", "Sell retail outlets", or "Become less capital intensive".

One each indicated "Expand transport deliveries", "Possibly sell out", "Expand wholesale operations", "Get into gasohol", or "Expand gasoline sales".
Results for the Crosstabulation of Questions 8 and 12

The process of crosstabulation involves the comparison of responses given to two separate questions. This study utilizes the crosstabulation of all four possible responses in Question 8 and one response from Question 12. Question 8 concerns the opinion of the respondent in regards to the future of LP-Gas as a motor fuel. The element of Question 12 employed in this study is about the plans of the respondent's company with respect to LP-Gas.

8. In your opinion, LP-Gas's future as a motor fuel is:
   (A) Good  (C) Poor
   (B) Fair   (D) Don't Know

12. My company plans to expand our product line to include LP-Gas.
   (A) Yes  (B) No

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CONCLUSIONS

The conclusions based on the results of this study are as follows:

1. A conclusion of this study is that a sizeable majority of the respondents sell gasoline and do not sell propane.  

2. A conclusion of this study is that a sizeable majority of the respondents sell fuel oil to rural customers and indicated that fuel oil sales are decreasing.

3. A conclusion of this study is that a majority of the respondents sell fuel oil to urban customers and indicated that customers state that natural gas furnaces are less expensive to operate than fuel oil furnaces.

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163 Dr. Jack T. Humbert, Class Lecture, Department of Distributive Education, Western Michigan University, March 16, 1981. The terms used in the "CONCLUSIONS" are defined as follows: (sizeable majority: 80-100%), (majority: 51-79%), (minority: 21-50%), (sizeable minority: 0-20%).

164 Dale E. Houston, Attitudes of Illinois Petroleum Jobbers About the Marketing of Propane, (Undergraduate Study), Western Michigan University, April, 1981, pp 67, 75.

165 Ibid., pp 71, 83.

166 Ibid., pp 71, 85.
4. A conclusion of this study is that a minority of the respondents plan to, "... withdraw from the fuel oil business," and indicated that conversion of fuel oil furnaces to propane "never" depends on "... future availability of natural gas."

5. A conclusion of this study is that a sizeable minority of the respondents believe that, "... propane has a good future as a motor fuel," and indicated that their companies plan to "... expand our product line to include propane."

---

167 Ibid., pp 91, 89.
168 Ibid., pp 80, 91.
ACCEPTANCE OR REJECTION OF HYPOTHESES

The following hypotheses are accepted or rejected:

1. A hypothesis of this study is that the percentage of Illinois petroleum jobbers marketing LP-Gas will increase due to the fact that LP-Gas sales will increase jobbership profitability.
This hypothesis is rejected.\(^{169}\)

2. A hypothesis of this study is that the Illinois LP-Gas market is expanding due to the fact that LP-Gas is less expensive than gasoline.
This hypothesis is accepted.\(^{170}\)

3. A hypothesis of this study is that fuel oil sales in rural Illinois are decreasing due to the fact that LP-Gas furnaces are less expensive to install than fuel oil furnaces.
This hypothesis is rejected.\(^{171}\)

4. A hypothesis of this study is that fuel oil sales in rural Illinois are decreasing due to the fact that LP-Gas furnaces are less expensive to operate than fuel oil furnaces.
This hypothesis is accepted.\(^{172}\)

\(^{169}\)Dale E. Houston, *Attitudes of Illinois Petroleum Jobbers About the Marketing of LP-Gas*, (Undergraduate Study), Western Michigan University, April, 1981, p. 91.

\(^{170}\)Ibid., p 79.

\(^{171}\)Ibid., p 87.

\(^{172}\)Ibid., p 87.
5. A hypothesis of this study is that Illinois petroleum jobbers have the belief that LP-Gas has a "poor" future as a motor fuel. This hypothesis is rejected.\textsuperscript{173}

\textsuperscript{173}Ibid., p 80.
RECOMMENDATIONS

The recommendations for this study are as follows:

1. A recommendation of this study is that members of the Illinois Petroleum Marketers Association review and analyze the results of this study.

2. A recommendation of this study is that members of the Midwest Petroleum Marketers Association review and analyze the results of this study.

3. A recommendation of this study is that petroleum marketing trade journal editors review and analyze the results of this study.

4. A recommendation of this study is that a study about the feasibility of installation of LP-Gas engines in passenger cars be conducted.

5. A recommendation of this study is that a study about the feasibility of installation of LP-Gas engines in city buses be conducted.
SOURCES CONSULTED

Books


Periodicals

Periodicals (Cont'd.)


___________. "Interview With Hugh F. Keepers of the LP-Gas Division of Texas About Those ESVs." LP-Gas, XL (November, 1980), 8-11.


Schultz, Mort. "Answers to the Questions About Converting Your Car to Propane." Popular Mechanics, CLVII (September, 1979), 48D-51D.
Periodicals (Cont'd.)


Government Publications


Government Publications (Cont'd.)


Unpublished Materials


International Harvester Corporation. "How to Reduce New Gas-Powered Truck Operating Costs." (Sales pamphlet)


Unpublished Materials (Cont'd.)


Personal Interviews

Detroit area petroleum jobber. Kalamazoo, Michigan, February 6, 1981.

Illinois petroleum jobber. February 6, 1981.


Mr. Larry Williams. Petroleum instructor. Western Michigan University, Kalamazoo, Michigan, January 3, 1981.

Personal Letters


Class Lectures

Delene, Dr. Linda M. Marketing Department, Western Michigan University, Kalamazoo, Michigan, March 30, 1982.

Humbert, Dr. Jack T. Class lecture, Department of Distributive Education, Western Michigan University, Kalamazoo, Michigan.
Class Lectures (Cont'd.)

Lambert, Mr. Tom. Lecture given at Western Michigan University, Kalamazoo, Michigan, November, 1980.

Lowry, Dr. George G. Class Lecture, Chemistry Department, Western Michigan University, Kalamazoo, Michigan, December, 1980.

Powell, Dr. Andrew F. Class lecture, Marketing Department, Western Michigan University, Kalamazoo, Michigan, November 18, 1980.

Williams, Mr. Lawrence. Class lecture, Department of Distributive Education, Western Michigan University, Kalamazoo, Michigan, 1978.
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**TOTAL HOURS AND COST**

306 $994.50
Hello IPMA Member! My name is Dale Houston. I am a student at Western Michigan University, Kalamazoo, majoring in Petroleum Distribution.

******************************
♦Please take a few minutes to ♦complete this questionnaire. ♦Your opinions and information ♦will greatly aid my study. ♦I will hold all answers in ♦STRICT CONFIDENCE!!
******************************

QUESTIONNAIRE

DIRECTIONS: Unless otherwise instructed, please put an "X" in front of the best response to each question.

1. What is your job title? __________________________

2. How long have you been in the petroleum business?
   ___ 0-5 Years   ___ 5-10 Years   ___ Over 10 Years

3. Indicate by no. 1 the product your company sells in the greatest volume to no. 4 for the least volume. (If a product DOES NOT APPLY, leave it blank!!)
   ___ Gasoline   ___ Diesel Fuel
   ___ Heating Oil   ___ Other, please specify...

4. Which customer categories does your company serve? ("X" ALL categories that apply)
   ___ Wholesale-Commercial   ___ Urban Home Heating
   ___ Farm   ___ Rural Home Heating
   ___ Retail Gasoline   ___ Other, please specify__________
5. What was your company's total gallonage (except lubricants) during 1980.
   ___ 0-2 Million Gals  ____ 10.1-20 Million Gals
   ___ 2.1-5 Million Gals  ____ 20.1-40 Million Gals
   ___ 5.1-10 Million Gals  ____ Over 40 Million Gals

6. Does your company sell LP-Gas?
   ___ No, Please continue.
   ___ Yes, Please go to question no. 11.

7. The following are characteristics of LP-Gas engines. Indicate by no. 1 what YOU FEEL the most important characteristic is to Consumers, to no. 3 for the least important.
   ___ LP-Gas exhaust emissions do not contribute to air pollution.
   ___ LP-Gas’s clean burning characteristics decrease engine wear.
   ___ LP-Gas costs less per gallon than gasoline.

8. In your opinion, LP-Gas's future as a motor fuel is:
   ___ In my opinion, LP-Gas has a good future as a motor fuel.
   ___ In my opinion, LP-Gas has a fair future as a motor fuel.
   ___ In my opinion, LP-Gas has a poor future as a motor fuel.
   ___ I don't know about the future of LP-Gas as a motor fuel.
8. A. Please list any strong points that YOU FEEL are characteristic of LP-Gas engines.


8. B. Please list any weak points that YOU FEEL are characteristic of LP-Gas engines.


9. My company's heating oil sales are:

___ Decreasing, Please continue.

___ Unchanged, Please go to question no. 11.

___ Increasing, Please go to question no. 11.

___ Does not apply, Please go to question no. 11.
10. My company's heating oil sales are decreasing because of conversions to: ("X" ALL that apply)

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11. In your opinion, heating oil customers convert to LP-Gas because of future availability of natural gas:

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12. The recent lifting of petroleum allocation regulations has prompted many companies to expand or contract their product lines. Your company's plans are:

____ My company plans to expand our product line to include coal.

____ My company plans to expand our product line to include LP-Gas.

____ My company plans to withdraw from the heating oil business.

____ Other, please specify...


Thank you for taking the time to complete this questionnaire. Your opinions and information are greatly appreciated. Your responses are STRICtly CONFIDENTIAL, and...

Thanks again
PURPOSE

The purpose of this study is to research and analyze application of liquid petroleum gas as a motor fuel. Conclusions of this study are located on page 7. Endnotes of this study are located on pages 8 and 9.
On April 23, 1980 the province of Ontario, Canada, gave liquid petroleum gas (LP-Gas) fueled motor vehicles two massive boosts. All over-the-road vehicles factory equipped to be propelled "... exclusively by hydrogen, propane (a common name for LP-Gas), natural gas, alcohol, and synthetic gas," were exempted from the Ontario sales tax. The Ontario Gasoline Tax Act of 1973 was amended to make, "... LP-Gas tax exempt in any motor vehicle," that same day. Prior to this amendment, LP-Gas was exempt from motor fuel taxes only if the fuel was used in unlicensed vehicles. This combination of tax exemptions lifted a seven percent sales tax on new LP-Gas propelled vehicles and a 20.9 cents per gallon motor fuel tax.  

The province of Ontario is utilizing these exemptions to provide incentive for use of a product produced in Canada. However, in recent years increasing numbers of commercial firms and private citizens are employing LP-Gas as a motor fuel for numerous reasons. The following are five primary reasons for use of LP-Gas as a motor fuel: first is that LP-Gas is extremely clean burning, second is that LP-Gas has a higher octane rating than gasoline, third is that LP-Gas is a dry fuel, fourth is that LP-Gas starts better in cold weather than
gasoline, and fifth is that LP-Gas costs less than gasoline or diesel fuel.²

Commercial firms using LP-Gas (hereafter referred to as LPG) as a motor fuel include Southern Bell, which has over 3400 vehicles operating on LPG.³ Yellow Cab converted 41 taxis to LPG in Charleston, South Carolina, during 1980.⁴ A concerted program is underway to convert 13,000 Michigan school buses to LPG. Nearly 150 buses had been converted by January 1981. These buses, which are in operation from Grand Rapids to Charlevoix, are being used in comparison to gasoline engine buses and general evaluation.⁵ Even private citizens are using LPG to fuel automobiles and pick-up trucks. Mort Schultz, an automotive editor of Popular Mechanics magazine, had a car converted to a LPG/gasoline dual fuel system in 1979.⁶ After 40,000 miles and a coast-to-coast trip, Mort had no major objections to this type of a dual fuel system.⁷

LPG is a mixture of paraffin gases heavier than methane (natural gas) that are pressurized to obtain a liquid. These gases are a by-product of the petroleum industry that can be obtained in two ways. All petroleum wells yield a percentage of these gases (which, along with natural gas, are referred to as light ends) along with oil, natural gas, and water. Fractional distillation in petroleum refineries yields light ends
in upper level distillation. In the United States 70 percent of domestically produced light ends are from wells and 30 percent from refining. Commercial grade LPG is a mixture of mostly normal propane \( \text{C}_3\text{H}_8 \) or normal butane \( \text{C}_4\text{H}_{10} \) and other paraffin gases. For instance, specifications as determined by ASTM test D-2163 for the composition of normal butane may be as follows: normal butane, minimum 95.5 percent; iso butane, maximum 3.5 percent; pentanes and heavier, maximum .5 percent, propane, maximum trace. (All percentages are by liquid volume.)

LPG is a very unstable substance when in storage or when drawn from storage. This is because LPG is extremely temperature/pressure sensitive. The withdrawal of LPG from a storage vessel lowers the pressure contained within that vessel. This causes the liquid to "boil" in an effort to restore the pressure by generating vapor to replace that which is withdrawn. The required latent heat of vaporization is surrendered by the liquid and causes the temperature of the liquid to drop as a result of the heat so expended. Heat lost from the liquid must be replaced by heat in the air around the vessel. Therefore, an LPG tank may be filled closer to its full water capacity in winter than in summer. A pressure relief valve bleeds off any excess pressure generated within the vessel. This inherent instability requires strong
storage vessels. All LPG storage vessels must pass exacting DOT and ASME regulations in addition to National Fire Protection Association (NFPA) regulations. Safety of LPG tanks in LPG propelled motor vehicles is often questioned. The NFPA requires those tanks to be much stronger than gasoline or diesel fuel tanks. According to the NFPA Pamphlet 58, section 213, paragraph (b), any portable LPG container must be able to withstand "...a blow from any direction equivalent to that of a 30 pound weight dropped four feet..." without endangering the valves.

Two types of LPG systems can be employed to power a motor vehicle. The first is a complete, straight LPG system using a modified gasoline engine. The second is a dual fuel (gasoline/LPG) system. There are six elements common to both the straight LPG and dual fuel systems. First, is a LPG storage vessel. In a passenger car the vessel is stationed in the trunk and isolated from the passenger compartment by a metal vapor barrier. Second, is a vapor filter located along the fuel line. Third, is a pressure regulator which reduces the LPG to a working pressure and controls the pressure of the LPG. Fourth, is a vaporizer which completes vaporization of the LPG. Fifth, is an atmospheric regulator which stores the LPG vapor. Sixth, is a simple carburetor which mixes the LPG vapors with air.
The dual fuel system, such as Mort Schultz uses, allows a vehicle to operate on either gasoline or LPG. This system utilizes a toggle switch to change the engine from LPG to gasoline. The fuel changing operation is the most decisive element of the dual fuel system and can even be done while the vehicle is being powered. If the two fuels mix, the engine will stall because the mixture of gasoline and LPG will flood the cylinders. This can only happen when switching from gasoline to LPG. When switching from LPG to gasoline no mixing occurs because the amount of LPG remaining in the fuel system is just enough to prevent the engine from stalling. This is prevented by holding the switch in a half-way position so that the flow of gasoline to the carburetor is shut off, but the LPG converter is not opened. The engine then runs on gasoline remaining in the carburetor bowl. When the engine begins to lose power (as gasoline runs out), the switch is turned to full LPG to open the LPG filter fuel lock in the converter. An EGR system is necessary to reduce NOx in gasoline operation, however, the EGR is disengaged during LPG operation.\(^{12}\)

In 1972 a 1970 Chevrolet Impala with a 350 CID engine and a four barrel carburetor was converted to a LPG system for performance evaluation. The car was fitted with a 28 gallon LPG tank and had a curb weight of 4930 pounds for the tests. Tire inflation was 24 psi in front
and 30 psi in the rear. The air to fuel (A/F) ratio was altered from 15 percent lean to 35 percent rich at idle.\textsuperscript{13} The spark timing was set at 6°btc and vacuum advance was used. An exhaust gas regeneration (EGR) system was employed in all parts of the test.\textsuperscript{14}

The car was tested on a dynomometer and in simulated driving conditions on the GM test track. The tests each had three phases. First, the car was operated at high speed idle, secondly was stop-start city "driven," and lastly was "driven" at a steady 70 mph highway speed.\textsuperscript{15} A conclusion of the test was that an LPG engine can operate on a leaner A/F ratio than a gasoline engine. Another conclusion was that an LPG engine has lower CO and HC emissions than a comparably-equipped gasoline engine. The final conclusion was that an LPG engine could not be operated lean enough to meet 1975-1976 emission standards. Therefore, emission equipment such as an EGR system or an NOx converter would be necessary after that date.\textsuperscript{16}

In 1973, a 637 CID V8 LPG engine in bus 8849 of the Chicago Transit Authority (CTA) was redesigned by two Phillips Petroleum Company engineers. Bus 8849 is the sole survivor of a large number of LPG buses purchased by the CTA between 1950 and 1963, when the engine manufacturer halted production of LPG engines.\textsuperscript{17}

Between 1965 and 1971 bus 8849 got 1.77 mpg. The first modification to the engine was a piston change to
reduce the compression ratio from 8.6:1 to 7.5:1. Secondly, smaller diameter plugs (AC 42 TS) were moved further up in the combustion chamber.\textsuperscript{18} These changes resulted in fuel consumption of 2.6 mpg with no performance sacrifices.\textsuperscript{19} Emission tests revealed that the engine emits 8.3g/bhp-h of CO and 9.9g/bhp-h of HC and NO\textsubscript{2}.\textsuperscript{19}

According to this study, a major advantage of this optimized LPG engine is that LPG has a lower initial cost per gallon compared to diesel fuel. Other advantages of LPG that are important to city bus operation are the lack of smoke and odor and quieter operation than diesel engines.\textsuperscript{20}
CONCLUSIONS

The conclusions of this study are as follows:

1. LPG costs less per gallon than gasoline or diesel fuel.
2. LPG burns cleanly in an engine.
3. LPG has a high octane rating (over 100).
4. LPG is consumed as a vapor by an engine, therefore a simple carburetor can be used.
5. LPG will not vapor lock.
6. LPG engines operate more quietly than diesel engines.
7. LPG engines lack the smoke and odor of diesel engines.
8. LPG systems require extensive space in passenger automobiles.
9. LPG is not widely distributed.
ENDNOTES


6 Mort Schultz, "Answers to Questions About Converting Your Car to Propane," Popular Mechanics, September, 1979, pp. 48A-50A.


8 Tom Lambert, Lecture given at Western Michigan University, November, 1980.


12 Mort Schultz, "Answers to Questions About Converting Your Car to Propane," Ibid.

14 Ibid., p. 4.
15 Ibid., p. 5.
16 Ibid., p. 12.
18 Ibid., p. 5.
19 Ibid., p. 11.
20 Ibid., p. 1.