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SOLAR THERMAL DISPERSED POWER PROGRAM IRRIGATION SYSTEMS PROJECT

TECHNICAL SUMMARY REPORT
31 MAY 1978

VOLUME II: AGRICULTURAL ENERGY AND FUEL PRICE
PROJECTIONS FOR ARIZONA, CALIFORNIA, KANSAS,
NEBRASKA, NEW MEXICO AND TEXAS

PREPARED FOR THE AEROSPACE CORPORATION
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Volume II

SOLAR-POWERED IRRIGATION SYSTEMS STUDY
TECHNICAL SUMMARY REPORT

VOLUME II

AGRICULTURAL ENERGY AND FUEL PRICE PROJECTIONS
FOR ARIZONA, CALIFORNIA, KANSAS, NEBRASKA, NEW MEXICO AND TEXAS

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FOREWORD

This volume contains the detailed agricultural energy price forecasts for the 1985-2015 period used by The Aerospace Corporation to assess the market potential of solar-powered irrigation systems. They were prepared under subcontract with Sherman H. Clark Associates, Menlo Park, California. Energy price forecasts in constant 1977 dollars are presented by aggregated county regions in the six states for four major sources of energy used in pumping of irrigation water: liquid petroleum gas (LPG), diesel fuel, natural gas, and electricity.

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1. INTRODUCTION

This report is part of a larger research effort to project U.S. energy demand and energy prices by state from 1985 to 2015; these projections will be used to assess the potential penetration into the U.S. energy economy by specific solar systems.

The Aerospace Corporation has selected the most promising six states from the standpoint of potential for the Solar Power Irrigation Systems being assessed. Since this subtask had an earlier deadline than the overall research effort, it was agreed to submit the results in tabular form only, together with a brief discussion of topics pertaining to this phase of the research. The underlying assumptions and specific energy price escalation and escalation factors are discussed in the main report.* All projected prices are given in 1977 dollars.

2. DISCUSSION

To determine present prices of agricultural fuels, a telephone survey has been conducted of electric and gas utilities, as well as oil and LPG distributors and wholesalers in the six-state area. On the basis of fuel and energy price similarity, 19 subregions were formed as follows:

Arizona	Pima County
	Other Southern Arizona
California	San Joaquin/Sacramento Valleys
	Imperial/Riverside Counties

* Solar Total Energy Systems, Final Technical Summary Report, Volume II-Energy Use and Price Forecasts, The Aerospace Corporation, ATR-78 (7692-01)-1, Vol II, (31 March 1978), Prepared for The Aerospace Corporation by Sherman H. Clark Associates.

Nebraska	Scotts Bluff County Other Western and South Central Nebraska
New Mexico	Central New Mexico (Albuquerque area) Other New Mexico
Kansas	Western Kansas
Texas	San Antonio area/Calhoun County Houston area Beaumont area Presidio County Haskell/Vernon Counties Central Texas (Glasscock/Comanche Counties and San Angelo area) Robertson County Brownsville West Texas Panhandle

The 1975 and 1977 prices and price projections through 2015 for electricity, natural gas, distillate oil, and LPG in these 19 subregions are provided in Tables 1 through 19. A more detailed breakdown of the survey results is given in the Appendix.

The prices subject to rate schedules (electricity and gas) represent averages based on total revenue and total energy for the rate schedule selected. Time periods covered are approximately nine months in 1977 and 12 months in 1975. Some 1975 data represent December 1975 actuals. When averages were not available from the utility, price data represent the rate applicable to a typical agricultural user.

Oil and LPG prices have been obtained from jobbers, distributors, and wholesalers; approximately three sets of information for each state were obtained.

The rate schedules used to compute average prices were those applicable to irrigation, whenever such specific schedules were available. The averages do not include schedules for rice and alfalfa drying, power for feedlot operations, and rural residential use.

Regional grouping was accomplished by grouping together those average prices with a range of less than 10 percent of each other (i.e., plus or minus 5 percent from a midpoint).

Taxes that must be paid by agricultural users are included; taxes that are likely to be refunded are excluded. Thus, a state sales tax is included in the price of electricity in Arizona and a "generating" tax is included in that of New Mexico.

2.1 Price Ranges

Whereas the range of surveyed prices for diesel oil and LPG is relatively small, substantial price differences exist in electricity and gas prices, as shown below:

	1977		High/Low Ratio
	<u>High</u>	<u>Low</u>	
Electricity (cents per kWh)	6.55¢	2.35¢	2.8
Gas (cents per therm)	26.7	9.1	2.9
Diesel (cents per gallon)	44.5	39.2	1.1
LPG (cents per gallon)	40.0	30.0	1.3

The electricity and gas price differences are attributable to several factors:

Some gas utilities may have access to relatively inexpensive "old" interstate gas supplies, whereas others may have to rely to a greater extent on nonregulated "new" intrastate supplies.

Some rate schedules may allocate a smaller share of costs to agricultural customers relative to residential or industrial customers, whereas others may do the opposite.

Some electric utilities, particularly rural cooperatives, have access to federal power, usually inexpensive hydroelectricity; others may have to rely on small and often relatively inefficient internal combustion power plants using oil fuel.

In the future, these relative price differences will tend to disappear because:

All incremental supplies of electric power and gas will be much more expensive than existing supplies, and although regional differences may still exist, they will be relatively small.

Federal intervention in the individual state's authority to set or approve rates can be expected, which will tend to bring rates by end uses more in line.

For 2015 we have thus projected price ranges that are much smaller than those currently existing, as shown below:

	1977		High/Low Ratio
	High	Low	
Electricity (cents per kWh)	8.5¢	6.1¢	1.4
Gas (cents per therm)	55.8	49.1	1.1
Diesel (cents per gallon)	78.6	75.4	1.0
LPG (cents per gallon)	76.6	71.0	1.1

2.2 Rate Schedules

All electricity and gas prices are subject to rate schedules. Rate schedules generally specify a minimum monthly billing amount and a declining rate structure, whereby the first block of power or gas is priced higher than the succeeding block, which in turn is priced higher than the block succeeding it. The average price paid is thus a function of consumption during the billing period.

For commercial service (including demand for irrigation pumps) the minimum bill is often tied to the amount of horsepower of the connected motor load, as illustrated in the following example for West Texas Utilities.

<u>Rate</u> <u>(cents per kWh)</u>	<u>Consumption</u> <u>(in kWh)</u>
7.42¢	First 75
5.30	Next 75
3.13	Next 2,500
2.12	All additional

Minimum bill: \$1.50, but not less than \$1.00 per hp of connected motor load for the first 10 hp, plus \$0.50 for each additional hp of connected motor load.

Very large agricultural operations may be subject to a demand plus an energy charge, as demonstrated by the following example for Pacific Gas and Electric Company in California:

<u>Rate</u>	<u>Demand</u>
Demand charge	
\$100.00	0-50 Kw
\$ 1.75 per Kw	All additional
Energy charge per kWh	
1.67¢	First 5,000 kWh
1.67	Next 100 kWh per Kw demand
1.19	Next 200 kWh per Kw demand
0.87	All additional

Minimum bill: The demand charge.

Gas rate schedules have a similar appearance, as demonstrated by the "Irrigation Pumping Gas Engine Schedule" of Southern Union Gas Company in New Mexico:

<u>Rate per Meter per Month (cubic feet)</u>	<u>Rate Per Thousand</u>
First 500,000	\$0.378
Next 500,000	0.319
Next 1,000,000	0.308
Over 2,000,000	0.283

Minimum monthly charge: \$5.00
per customer.

These schedules have evolved based on the costs to supply customers with different quantities of power or energy; i.e., it costs less per unit to supply a customer with 100,000 kWh or 2 million cubic

feet per month than with 100 kWh or 200 cubic feet, respectively. However, a philosophy evolving in this country holds that because both electricity and gas are or make use of limited and nonrenewable resources, the cost of production and transportation become unimportant relative to the societal cost of losing these nonrenewable resources. Large consumption--under this philosophy--should therefore be penalized and conservation should be rewarded, i.e., an inverse rate structure should be established.

We cannot predict whether one argument or the other will ultimately win; our best guess at this time is that rate schedules will converge toward a middle ground--close to a uniform price for all kWh or therms, regardless of whether they represent the first or the last unit used. This will be a slow process, however, and is not likely to be achieved uniformly much before 2000.

In the meantime, rate structures will favor the large user of electricity or gas, and obtaining portions of the pumping energy from a solar system will increase the cost of the remaining electricity or gas used. In addition, the introduction of time-of-day pricing may impact on the cost of electricity and gas for irrigation.

Table 1

AGRICULTURAL ENERGY AND FUEL PRICES
IN ARIZONA'S PIMA COUNTY
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	34.0¢	37.1¢	14.0¢	5.6¢
1977	37.2	39.1	18.2	6.0
Projected				
1985	55.5	57.4	26.4	6.4
1990	61.5	63.5	40.7	6.5
1995	68.5	70.4	49.1	6.8
2000	75.5	77.3	53.9	7.1
2005	75.5	77.6	54.3	7.6
2010	76.0	77.9	53.3	8.0
2015	76.0	78.1	53.3	8.5

Source: SHCA.

Table 2

AGRICULTURAL ENERGY AND FUEL PRICES
IN SOUTHERN ARIZONA, EXCEPT PIMA COUNTY
1975-2015

	<u>LPG</u> <u>(cents</u> <u>per gallon)</u>	<u>Diesel</u> <u>(cents</u> <u>per gallon)</u>	<u>Natural Gas</u> <u>(cents</u> <u>per therm)</u>	<u>Electricity</u> <u>(cents</u> <u>per Kwh)</u>
Actual				
1975	34.5¢	38.0¢	5.3¢	2.5¢
1977	38.0	40.0	9.7	3.0
Projected				
1985	56.0	58.0	17.9	3.4
1990	62.0	64.0	32.4	3.7
1995	69.0	71.0	41.5	4.1
2000	76.0	78.0	47.0	4.6
2005	76.2	78.2	48.0	5.2
2010	76.4	78.4	48.3	5.8
2015	76.6	78.6	48.8	6.4

Source: SHCA.

Table 3

AGRICULTURAL ENERGY AND FUEL PRICES
IN CALIFORNIA'S SAN JOAQUIN AND SACRAMENTO VALLEYS
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	35¢	34.2¢	11¢	3.1¢
1977	40	39.2	19	3.5
Projected				
1985	55	54.5	34	4.0
1990	62	60.8	42	4.4
1995	69	67.7	49	4.8
2000	76	74.6	54	5.1
2005	76	74.8	54	5.3
2010	76	75.2	53	5.7
2015	76	75.4	53	6.1

Source: SHCA.

Table 4

AGRICULTURAL ENERGY AND FUEL PRICES
IN CALIFORNIA'S IMPERIAL VALLEY/RIVERSIDE COUNTY
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	35¢	40.5¢	11¢	2.4¢
1977	40	41.9	20	2.9
Projected				
1985	55	56.1	34	3.6
1990	62	62.4	42	4.0
1995	69	69.3	49	4.5
2000	76	76.2	54	4.9
2005	76	76.4	54	5.2
2010	76	76.8	53	5.6
2015	76	77.0	53	6.1

Source: SHCA.

Table 5

AGRICULTURAL ENERGY AND FUEL PRICES
IN NEBRASKA'S SCOTTS BLUFF COUNTY
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	28.5¢	37.1¢	8.6¢	2.3¢
1977	34.5	44.5	13.3	2.6
Projected				
1985	47	56.5	29.2	3.6
1990	53	62.3	42.0	4.2
1995	59	69.2	51.3	5.0
2000	68	76.1	56.1	5.4
2005	69	76.3	56.0	5.8
2010	70	76.7	55.5	6.3
2015	71	76.9	55.6	6.9

Source: SHCA.

Table 6

AGRICULTURAL ENERGY AND FUEL PRICES
IN SOUTHERN AND WESTERN NEBRASKA,
EXCEPT SCOTTS BLUFF COUNTY
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	28.5¢	37.1¢	8.6¢	3.2¢
1977	34.5	44.5	13.3	4.4
Projected				
1985	47	56.5	29.2	4.7
1990	53	62.3	42.0	5.0
1995	59	69.2	51.3	5.7
2000	68	76.1	56.1	6.1
2005	69	76.3	56.0	6.5
2010	70	76.7	55.5	7.0
2015	71	76.9	55.6	7.6

Source: SHCA.

Table 7

AGRICULTURAL ENERGY AND FUEL PRICES
IN CENTRAL NEW MEXICO (ALBUQUERQUE)
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.3¢	35.4¢	7.4¢	2.9¢
1977	40.0	41.5	16.9	3.3
Projected				
1985	54.1	55.6	21.7	3.8
1990	60.2	61.7	36.0	4.3
1995	67.1	68.6	44.7	4.6
2000	74.0	75.5	49.6	5.0
2005	74.3	75.8	50.2	5.5
2010	74.6	76.1	49.4	6.2
2015	74.8	76.3	49.6	6.8

Source: SHCA.

Table 8

AGRICULTURAL ENERGY AND FUEL PRICES
IN NEW MEXICO, EXCEPT CENTRAL (ALBUQUERQUE)
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.3¢	35.4¢	8.0¢	3.0¢
1977	40.0	41.5	13.2	3.5
Projected				
1985	54.1	55.6	20.5	3.9
1990	60.2	61.7	35.0	4.3
1995	67.1	68.6	43.7	4.6
2000	74.0	75.5	48.7	5.0
2005	74.3	75.8	49.4	5.5
2010	74.6	76.1	48.8	6.2
2015	74.8	76.3	49.1	6.8

Source: SHCA.

Table 9

AGRICULTURAL ENERGY AND FUEL PRICES
IN WESTERN KANSAS
1975-2015

	<u>LPG</u> <u>(cents</u> <u>per gallon)</u>	<u>Diesel</u> <u>(cents</u> <u>per gallon)</u>	<u>Natural Gas</u> <u>(cents</u> <u>per therm)</u>	<u>Electricity</u> <u>(cents</u> <u>per Kwh)</u>
Actual				
1975	28.5¢	37.0¢	6.6¢	2.8¢
1977	34.5	44.5	9.1	3.4
Projected				
1985	47	56.1	26.4	4.3
1990	53	62.0	39.2	4.6
1995	59	68.0	48.6	5.0
2000	68	75.7	53.4	5.3
2005	69	75.9	53.3	5.7
2010	70	76.3	52.8	6.2
2015	71	76.5	52.9	6.7

Source: SHCA.

Table 10

AGRICULTURAL ENERGY AND FUEL PRICES
IN TEXAS, SAN ANTONIO AND CALHOUN
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.5¢	35.4¢	20.3¢	3.4¢
1977	38.5	40.5	26.6	4.0
Projected				
1985	54.0	56.0	33.7	5.2
1990	60.3	62.3	43.6	5.6
1995	67.5	69.5	50.1	5.8
2000	74.4	76.4	55.8	6.0
2005	74.6	76.6	56.2	6.4
2010	75.0	77.0	55.6	6.6
2015	75.2	77.2	55.8	7.2

Source: SHCA.

Table 11

AGRICULTURAL ENERGY AND FUEL PRICES
IN TEXAS, HOUSTON AREA
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per kWh)
Actual				
1975	33.5¢	35.4¢	19.0¢	2.3¢
1977	38.5	40.5	26.7	3.1
Projected				
1985	54.0	56.0	33.7	4.2
1990	60.3	62.3	43.6	4.7
1995	67.5	69.5	50.1	5.0
2000	74.4	76.4	55.8	5.2
2005	74.6	76.6	56.2	5.6
2010	75.0	77.0	55.6	5.8
2015	75.2	77.2	55.8	6.4

Source: SHCA.

Table 12

AGRICULTURAL ENERGY AND FUEL PRICES
IN TEXAS, BEAUMONT AREA
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.5¢	35.4¢	19.0¢	1.8¢
1977	38.5	40.5	26.7	2.4
Projected				
1985	54.0	56.0	33.7	3.7
1990	60.3	62.3	43.6	4.2
1995	67.5	69.5	50.1	4.5
2000	74.4	76.4	55.8	4.7
2005	74.6	76.6	56.2	5.1
2010	75.0	77.0	55.6	5.4
2015	75.2	77.2	55.8	6.1

Source: SHCA.

Table 13

AGRICULTURAL ENERGY AND FUEL PRICES
IN TEXAS, PRESIDIO COUNTY
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.5¢	35.4¢	23.2¢	3.4¢
1977	38.5	40.5	25.3	3.9
Projected				
1985	54.0	56.0	33.7	5.1
1990	60.3	62.3	43.6	5.5
1995	67.5	69.5	50.1	5.7
2000	74.4	76.4	55.8	5.9
2005	74.6	76.6	56.2	6.3
2010	75.0	77.0	55.6	6.5
2015	75.2	77.2	55.8	7.1

Source: SHCA.

Table 14

AGRICULTURAL ENERGY AND FUEL PRICES
IN TEXAS, HASKELL-VERNON COUNTIES
1975-2015.

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.5¢	35.4¢	11.9¢	4.5¢
1977	38.5	40.5	20.8	5.0
Projected				
1985	54.0	56.0	30.1	6.3
1990	60.3	62.3	40.2	6.7
1995	67.5	69.5	48.9	6.9
2000	74.4	76.4	54.6	7.1
2005	74.6	76.6	55.0	7.5
2010	75.0	77.0	54.4	7.7
2015	75.2	77.2	54.6	8.3

Source: SHCA.

Table 15

AGRICULTURAL ENERGY AND FUEL PRICES
IN TEXAS, CENTRAL REGION
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.0¢	35.4¢	11.9¢	3.3¢
1977	38.0	40.0	20.8	3.8
Projected				
1985	53.5	55.5	30.1	5.0
1990	59.8	61.8	40.2	5.4
1995	67.0	69.0	48.9	5.6
2000	73.9	75.9	54.6	5.8
2005	74.1	76.1	55.0	6.2
2010	74.5	76.5	54.4	6.4
2015	74.7	76.7	54.6	7.0

Source: SHCA.

Table 16

AGRICULTURAL ENERGY AND FUEL PRICES
IN TEXAS, ROBERTSON COUNTY
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.5¢	35.4¢	11.9¢	1.8¢
1977	38.5	40.5	20.8	2.4
Projected				
1985	54.0	56.0	30.1	3.7
1990	60.3	62.3	40.2	4.2
1995	67.5	69.5	48.9	4.5
2000	74.4	76.4	54.6	4.7
2005	74.6	76.6	55.0	5.1
2010	75.0	77.0	54.4	5.4
2015	75.2	77.2	54.6	6.1

Source: SHCA.

Table 17

AGRICULTURAL ENERGY AND FUEL PRICES
IN TEXAS, BROWNSVILLE
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.5¢	35.4¢	19.5¢	3.4¢
1977	38.5	40.5	17.5	4.0
Projected				
1985	54.0	56.0	31.3	5.2
1990	60.3	62.3	41.4	5.6
1995	67.5	69.5	50.1	5.8
2000	74.4	76.4	55.8	6.0
2005	74.6	76.6	56.2	6.4
2010	75.0	77.0	55.6	6.6
2015	75.2	77.2	55.8	7.2

Source: SHCA.

Table 18
AGRICULTURAL ENERGY AND FUEL PRICES
IN WEST TEXAS
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	33.5¢	35.4¢	10.8¢	1.5¢
1977	38.5	40.5	17.1	2.5
Projected				
1985	54.0	56.0	29.0	3.8
1990	60.3	62.3	39.1	4.3
1995	67.5	69.5	47.8	4.6
2000	74.4	76.4	53.5	4.8
2005	74.6	76.6	53.9	5.2
2010	75.0	77.0	53.3	5.5
2015	75.2	77.2	53.5	6.2

Source: SHCA.

Table 19

AGRICULTURAL ENERGY AND FUEL PRICES
IN TEXAS, PANHANDLE
1975-2015

	<u>LPG</u> (cents per gallon)	<u>Diesel</u> (cents per gallon)	<u>Natural Gas</u> (cents per therm)	<u>Electricity</u> (cents per Kwh)
Actual				
1975	25¢	35.0¢	11.4¢	2.1¢
1977	30	40.0	14.4	3.0
Projected				
1985	46	55.6	29.6	4.0
1990	53	61.8	39.7	4.5
1995	61	69.0	48.4	4.8
2000	69	75.9	54.1	5.0
2005	70	76.1	54.5	5.4
2010	71	76.5	53.9	5.6
2015	72	76.7	54.1	6.2

Source: SHCA.

APPENDIX

DELIVERED FUELS AND ENERGY COSTS--AGRICULTURAL USE

A detailed breakdown of survey results for delivered fuels and energy costs related to agricultural use is presented in this Appendix.

Table A-1

DELIVERED FUELS AND ENERGY COSTS--AGRICULTURAL USE

State/Area	Natural Gas						Electricity						Diesel			Propane/LPG				
	Schedule		1977		Price Unit	1975	Schedule		Cents per Kwh			(cents per gallon)			(cents per gallon)					
	Number	Name	Range	Avg.			Number	Name	1977		1975	1977		1975	1977		1975	1977		1975
									Range	Avg.		Range	Avg.		Range	Avg.		Range	Avg.	
Texas																				
N.W. Texas, E. of Pampa	--	Irrig. Rate ^{a/}		2.16	1.24	\$/Mcf	040	Irrigation		3.64¢	3.08¢	37.5-49.5¢	40.0¢	--¢	28-32¢	30¢		(25)¢		
N.W. Texas, W. of Pampa		Irrig. Rate		14.37	11.39	c/Therm	145	Large Industrial	2.6-3.3¢	3.04	2.06				28-32	30		(25)		
W. Texas, El Paso Co., Pecos	46, 11	Irrigation ^{b/}	168-195	1.71	(1.08)	\$/Mcf	503-HR	Farm Service	2.6-3.3	2.50	1.46									
Presidio	--	Resid. and Comm.*		2.53	2.32	\$/Mcf	FI	Farm Irrig.		2.40	--									
Vernon	--	Irrig. Rate ^{a/}		2.16	1.24	\$/Mcf	--	Rural Irrig.		3.90	3.40									
Haskell	--	Irrig. Rate ^{a/}		2.16	1.24	\$/Mcf	--	Irrigation		4.98	4.48									
Comanche		Irrig. Rate ^{a/}		2.16	1.24	\$/Mcf	RSR [†]	Rural Rate		4.98	4.48									
San Antonio	G	Gen. Service ^{c/}		27.22	22.1	c/Ccf	GS	Gen. Service Irrig.		3.70	3.40									
Robertson		Irrig. Rate ^{a/}		2.16	1.24	\$/Mcf	SIP 28#	Small Irrig.		7.20	5.50	39-41	40.5	(35.4)	38.5		(33.5)			
Houston		Irrigation		2.80	(2.00)	\$/Mcf	SIC 700	Agric. Service		4.00	3.40									
		Food Process (e.g., Rice Drying) ^{d/}		2.70	(1.80)	\$/Mcf	LGS	Large Gen. Serv.*		4.58	3.88									
Calhoun		Food Process (e.g., Rice Drying) ^{d/}		2.70	(1.80)	\$/Mcf	SIC 4971	Irrig. Systems		2.35	1.77				40.5	--	38.5	(33.5)		
Beaumont		Food Process (e.g., Rice Drying) ^{d/}		2.70	(1.80)	\$/Mcf	MGS	Miscell. (Comm.)		3.10	2.33									
Brownsville		Gen. Service*		2.70	(1.80)	\$/Mcf	--	Small Irrig.		2.87	2.08									
Glasscock		No Natural Gas Service--All on Butane ^g		1.75	1.90-2.00	\$/Mcf	LGS	Large Gen. Serv.*		4.00	3.40									
San Angelo		Irrig. Rate ^{a/}		2.16	--	--	SIP 28#	Small Irrig.		3.90	3.40									
				1.24	--	--	--	Rural Irrig.		3.90	3.40									
California																				
San Joaquin-Sacramento Valleys		<50 Mcf per mo.		21.9	15.7	c/Therm		Elec. Irrig.		5.40	3.10	36.4-41.8	39.2	34.2	37-55	40*		(35)*		
Kern, King, Tulare and S. Fresno Co.		<50 Mcf per mo. (Gas Engine)	18.8-21.9	19.0	(11.0)	c/Therm		Elec. Irrig.		5.40	3.10	36.4-41.8**	41.6	36.2	37-55	40*		(35)*		
Imperial--Riverside	G45	Pumping		20.0	10.5	c/Therm	P-A	Agric. Pump Serv.		2.90	2.36	38.3-40.7††	39.5	38.2	37-55	40*		(35)*		
	GNR	Agric. (e.g., Drying)	18.8-19.8	19.3	--	c/Therm	A-1	Commercial		3.20	2.60	38.3-40.7††	41.9	40.5						
Arizona																				
Phoenix (S. Arizona, excl. Pima and Safford)	G-17	Irrigation		9.72	5.27	c/Therm	E-38	Elec. Irrig.		3.00	2.50	39.1**	37.1**	34.6-39.9**	37.2**	26.0-41.6¢**		(34)**		
Safford	G-17	Irrigation		9.72	5.27	c/Therm	E-38	Elec. Irrig.		3.00	2.50	47.9**	45.1**		48.9**		(37.9)**			
Pima	70	Gen. Serv., Summer		18.20	14.01	c/Therm	10	Gen. Serv.		6.55	5.55	39.1**	37.1**	34.6-39.9**	37.2**	26.0-41.6 **		(34)**		
New Mexico																				
East New Mexico	Various	Gen. Irrig.		1.24	0.73	\$/Mcf	040	Irrigation		3.64	3.08									
							145	Large Industrial	2.6-3.3	3.04	2.06									
North Central	30+ Various	Irrigation ^{b/}	1.69-1.58	1.69	0.74	\$/Mcf	10	Irrigation		3.27	2.88	41.5**	35.4**	40-41.5**	40**		(33.3)**			
North West	30+ Various	Gen. Irrig. ^{b/}		1.29	0.83	\$/Mcf				(3.27)	(2.88)									
South West	30+ Various	Gen. Irrig. ^{b/}		1.39†	0.88	\$/Mcf	10	Irrigation		3.27	2.88									
Hidalgo	30+ Various	Gen. Irrig. ^{b/}		1.39†	0.88	\$/Mcf	503-HR	Farm Service		2.50	1.46									
State average				1.26	0.73															
Kansas																				
W. Kansas	1-8	Irrigation		0.86	0.62	\$/Mcf	74-IR	Irrig.		3.35	2.75	44.5	37	34-39	34.5	28-29	28.5			
	10	Alfalfa Drying		(0.70)	0.50	\$/Mcf	74-DR	Drying		3.69	3.24									
		Commercial ^{e/}		(1.00)	0.75	\$/Mcf	76A-IP-1	Irrig.		4.61	2.29									
Nebraska																				
Scotts Bluff Co.	--	Irrigation		1.26	0.82	\$/Mcf	--	Irrigation		2.64	2.31	44.5	37.1	34-35	34.5	28-29	28.5			
	--	Alfalfa Drying		(1.10)	0.67	\$/Mcf	--	Rural Resid.		2.79	1.98									
		Commercial ^{f/}		(1.45)	0.97	\$/Mcf														
W. Nebraska		Commercial ^{f/}		(1.45)	0.97	\$/Mcf	--	Irrigation		(4.17)	1.97									
							A-1	Farm Resid.		(4.00)	2.23									
Antelope--Holt		Commercial ^{f/}		(1.45)	0.97	\$/Mcf		Irrigation		4.15	3.17									
								Large Farm; Rural Resid.		(3.50)	2.54									
Platte, Boone, Nance		Commercial ^{f/}		(1.45)	0.97	\$/Mcf	I	Irrigation		4.15	3.17									
							A&B	Large Farm; Rural Resid.		(3.50)	2.54									
S. Nebraska		Commercial ^{f/}		(1.45)	0.97	\$/Mcf	Irrig-1	Irrigation		(4.39)	3.30									
							RGS-1	Rural, Nonresid.		(4.28)	3.24									

Notes: Ranges are for regional averages, not individual rates. Averages are approximate weighted averages. Numbers in parenthesis () are estimated.

* Have few or no irrigation customers. † With Rider "FPS". ‡ 1975 Schedule No. was No. 47. § Typical of feed-lot use. ■ Deliveries in 8,000 gallon lots: 36.4-37 cents per gallon; "Bobtail or Tankerwagon" lots: 40.7-41.5 cents per gallon; if not "exempt" add 6% sales tax (average equals 41.6 cents per gallon).
 • For agricultural pumping; 1,000 gallons per week; company supplies tank. ** Includes state tax. †† Includes 6% tax. ‡‡ Includes 4% tax in New Mexico; 5% tax for Arizona in 1977 (4% in 1975); and 3% tax in Kansas. §§ Wholesale, Rack, San Antonio: 34.5 cents per gallon. ■■ Rate is 9 month average for 1977 (through September); rate increased about 15 cents on November 1, 1977.

Source: SHCA.

a/ 1,040 Btu per cubic foot.
 b/ 1,000 Btu per cubic foot.
 c/ 1,020 Btu per cubic foot.
 d/ 1,048 to 1,100 Btu per cubic foot.
 e/ 940 Btu per cubic foot.
 f/ 950 Btu per cubic foot.