

ENERGY SOURCES AND USES IN IRAN
A BRIEF REVIEW

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Preface

This report is one of a series describing a multi-disciplinary multinational IIASA research study on Management of Energy/Environment Systems. The primary objective of the research is the development of quantitative tools for energy and environment policy design and analysis -- or, in a broader sense, the development of a coherent, realistic approach to energy/environment management. Particular attention is being devoted to the design and use of these tools at the regional level. The outputs of this research program include concepts, applied methodologies, and case studies. During 1975, case studies were emphasized; they focused on three greatly differing regions, namely, the German Democratic Republic, the Rhône-Alpes region in southern France, and the state of Wisconsin in the U.S.A. The IIASA research was conducted within a network of collaborating institutions composed of the Institut für Energetik, Leipzig; the Institut Économique et Juridique de l'Énergie, Grenoble; and the University of Wisconsin, Madison.

The research is being extended in 1976 to an additional region(s). This paper provides a brief review of energy sources and uses in Iran in preparation for a regional study in that country.

Wesley K. Foell

Energy Sources and Uses in Iran - A Brief Review

Mehdi N. Bahadori

INTRODUCTION

A thorough study of the energy sources and uses in Iran is rather difficult due to the lack of accurate statistical data. The information provided by many sources do not always agree with each other and are often incomplete. In making this study, the information available (References 1 - 11) have been employed to construct the tables, but the data of one reference (7) which seemed to be more consistent and more complete than the others were primarily used to plot the curves. A more complete study of the energy picture in Iran requires much more time than was available to the writer and requires a thorough examination of the many reports and information published by the governmental and private organizations in the past several years.

In the following few pages, a background information on the geography and people are first given, followed by a brief description of energy sources and uses.

Geography and People

Iran, located in southwestern Asia between the Caspian Sea and the Persian Gulf, shares borders with the USSR, Afghanistan, Pakistan, Iraq and Turkey. Figure 1 shows the principal towns, oil fields, pipelines and railroads in Iran (8). The topography consists mainly of interior desert plains and highlands. These are surrounded by a rugged mountain rimland, 1800-5400 m above

sea level (almost $\frac{1}{2}$ of the total land area) which is dissected by deep valleys and gorges and a few plains areas⁽³⁾. The total land area is 1,648,000 km² with the following distribution⁽²⁾.

Agricultural	14%
Forested	11%
Desert & Urban	51%
Cultivable with adequate water	16%
Nomadic (migratory grazing & others)	8%

Iran's climate is diversified, primarily because of its topography. Annual precipitation ranges from less than 200 mm in the interior and the south to over 1000 mm along the Caspian Sea coast⁽³⁾. Winters are very cold in the north but warmer in the south. Summers are basically hot and dry during the day and pleasant at night.

The distribution of Iran's population is strongly influenced by climate and geography. About 70% of the country--mostly mountain and desert areas--is virtually uninhabited. A large-scale migration of Iranians from rural to urban areas has occurred in the past ten years because of rapid industrialization of the country. Nearly half the population now lives in the cities and nearly half the population is under 15 years of age⁽³⁾. There were 642,000 nomadic tribesmen reported in 1966⁽³⁾. Table 1 gives the population distribution in Iran by sex and urban settlement, Table 2 the population distribution by sex and age, and Table 3 the population of major cities in Iran⁽⁴⁾. The total labor force was 7.5 million⁽²⁾ in 1972, and 9.4 million in 1974 with the following distribution⁽¹⁰⁾:

Agriculture	40%
Industries	30%
Services	30%

Education

Although education up to primary school is compulsory, still the illiteracy rate in the country is rather high. Table 4 gives the illiteracy rate in Iran in 1966 and Table 5 the number of schools, students and teaching staff at various levels. There have been massive efforts on the part of the government and the people in the past ten years to reduce the illiteracy rate, especially in the villages where the rate has been very high.

Transportation and Communication

Table 6 gives some information on the transportation and communication in Iran^(1,2).

ENERGY SOURCES

Petroleum has been the major energy source in Iran. Iran is the second largest exporter and the fourth largest producer of oil in the world, accounting for approximately 10% of total world output. Over the past decade the oil production has grown at an average annual rate of 15%⁽¹¹⁾, from 71.72×10^9 kg in 1963 to 294.63×10^9 kg in 1974⁽⁷⁾, providing the major revenue for the country's development. The proved reserves of oil, estimated at 60×10^9 barrels⁽⁷⁾ (9.54×10^9 m³ or 8.214×10^{12} kg) makes Iran the fourth largest (after Saudi Arabia, USSR, and Kuwait⁽¹¹⁾), and the proved reserves of natural gas is estimated at⁽⁷⁾ $270-395 \times 10^{12}$ ft³ ($7.65-11.2 \times 10^{12}$ m³).

In addition to petroleum, other sources of energy have been employed in the past or will be utilized in future. Table 7 gives the sources of energy in Iran along with a projection up to 1992. The energy values of the sources are given, using the following conversion factors⁽¹⁶⁾.

Energy value of 1 kg coal	= 8 kwh	= 6884 kcal
" " " 1 ft ³ natural gas	= 1,030.4 Btu	= 259.69 kcal
" " " 1 m ³ natural gas	= 9169.5 kcal	
" " " 1 kg crude oil	= 10.4 kwh	= 8949.2 kcal
" " " 1 kg kerosene, gasoline, or fuel oil	= 12 kwh	= 10326 kcal
" " " 1 kg LPG	= 13.36 kwh	= 11,496 kcal

Figures 2 and 3 show, respectively, the energy sources and their percentages, using the data of Ref. 7. It is clear from the table and these figures that Iran is planning to rely on nuclear energy and natural gas to meet its future needs and to utilize its liquid fuel and coal resources for industrial applications, especially petrochemical and steel, respectively. While the use of solar energy is not cited in the literature searched, it is, however, believed that it will play some role in meeting the energy needs of the country, especially after 1990, in heating and cooling, desalination, industrial applications, power production, etc. Table 8 and Figure 4 give the petroleum users in Iran by products. Important in the figure is the rate of oil-production gases which are flared. Part of this gas is to be exported and used in chemical industries.

ELECTRICAL ENERGY PRODUCTION

Electrical energy has changed from a luxury item in about 40 years, to a necessity in today's life of most of Iranians. Table 9 and Figures 5 and 6 show the installed power for electrical energy generation as well as the generated energy. In addition, to the energy generated by the Ministry of Power which constitutes about 90% of the total generation, there are still small municipalities and industries with their own electrical energy generation capabilities. Some of these industries in Tehran and other cities in the past have been able to satisfy their own needs during the day and help the city power plants to meet the peak demands at night. The significance of these "private" plants is diminishing as it becomes easier, cheaper, and more reliable to purchase electricity from the Ministry of Power than privately generating it. The machinery used by the private sources to generate electricity has been predominantly diesel engines. This is not, however, included with that of the Ministry of Power. The source for electrical energy production has been liquid fuels and natural gas, with steam turbines playing a major role in the energy conversion. Significance of the role of nuclear energy beyond 1982 is clear from Table 9 and Figure 5 and 6. It is expected that 30% of the electrical and 20% of the total energy of the country will be met by nuclear energy in 1992⁽⁷⁾.

The uses of electrical energy generated by the Ministry of Power are given in Table 10 and Figures 7 and 8. Data on the end use of the electricity generated by "private" firms are not available. However, a higher percentage for the industrial sector, as that given in Table 10 and Figure 8, may be assumed for it.

ENERGY CONSUMPTION AND ECONOMIC DEVELOPMENT

The oil revenues in the past few years have contributed greatly to the industrial and economic development of the country. Table 11 gives the shares of various sectors to the gross domestic product, the gross national product, and the per capita GNP⁽¹⁰⁾. This table shows once more the significance of the oil revenues in the country's development, and a shift from an agricultural and industrial economy to primarily an oil-exporting economy. Table 12 and Figure 9 show the growth of the per capita consumption of electrical and the total energies, the GNP and the population.

CONCLUSION

Oil has been the primary source of energy in Iran in the past 20 years and continues to be a major source in the next 15 years. The use of natural gas is becoming more popular, especially in domestic and commercial applications, as more cities become equipped with natural gas piping. Nuclear energy is to play an important role in meeting the country's energy needs beyond 1990, and it is believed that solar energy will be utilized to some extent beyond 1990 also.

The per capita total and electrical energy consumptions and GNP have been increasing rather rapidly, showing a higher industrialization and a higher standard of living in Iran.

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Table 1: Population Distribution in Iran by Sex and Urban Settlement (a)

	Total Population 10 ⁶	URBAN		MALE POPULATION			FEMALE POPULATION		
		Num. 10 ⁶	%	Total	Urban		Total 10 ⁶	Urban	
					Num. 10 ⁶	%		Num. 10 ⁶	%
1965	24.87	9.33	37.5						
1966	25.08	9.79	39.1	12.98	5.09	39.3	12.097	4.7	38.8
1967	26.8	10.35	38.6						
1968	27.6	10.86	39.4						
1969	28.4	11.36	40						
1970	29.25	11.9	40.7						
1971	30.16	12.46	41.3	15.57	6.48	41.6	14.589	5.98	41.
1972	31.095	13.034	41.9						
1973	32.076	13.670	42.6						

(a) Ref. 4, p.114

Table 2: Population Distribution in Iran by Sex and Age (a) - In Millions

	Total		0-9 yrs.		10-19		20-29		30-39		40-49		50-up	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1966	12.981	12.097	4.426	4.108	2.654	2.492	1.595	1.737	1.627	1.459	1.217	.947	1.462	1.354
1967														
1968														
1969														
1970														
1971	15.57	14.589	5.302	5.029	3.578	3.339	2.311	2.148	1.658	1.549	1.196	1.119	1.525	1.405
1972														
1973														
1974														

(a) Ref. 4, p.156.

Table 3: Population of the Major Cities of Iran (a)

	Tehran	Esfahan	Mashhad	Tabriz	Shiraz	Abadan	Ahvaz	Kermanshah	Rasht	Ghom	Rezaeyeh
1966	2,719,732	424,045	409,616	403,413	269,865	272,962	206,375	187,930	143,557	134,292	110,749
1972	3,858,000	575,000	562,000	493,000	356,000	306,000	286,000	239,000	170,000	164,000	148,000

(a) Ref. 4, p.203

Table 4: Illiteracy Rate in Iran in 1966; 15 years and Over

			MALE			FEMALE		
Total Popul.	Illiterate	%	Total	Illiterate	%	Total	Illiterate	%
13,485,314	10,407,726	77.2	6,939,523	4,663,164	67.2	6,545,791	5,744,562	87.8

(a) Ref. 4, p. 492

Table 5: Public Education at Various Levels (a)

	No. of Schools					No. of Students (thousands)					No. of Teaching Staff				
	Primary	Secondary (total)	Vocational	Teacher's Train.	Colleges	Primary	Secondary (total)	Vocational	Teacher's Train.	Colleges	Primary	Secondary	Vocational	Teacher's Train.	Colleges
1965	15,135	1,715	105	52	36	2,182	561	15.2	4.7	29.0	72,867	20,101	1,274	229	2,486
1966	14,740	1,864	118	64	51	2,378	658	16.	5.7	36.7	75,502	23,393	1,159	463	2,772
1967	15,429	2,098	138	93	65	2,576	691	16.2	6.7	46.9	81,127	24,516	1,620	362	3,382
1968	15,556	2,332	154	111	73	2,753	807	19.0	6.0	58.1	85,157	26,370	1,727	391	3,360
1969	15,776	2,588	164	126	81	2,916	921	23.3	9.4	67.3	89,320	28,444	2,050	504	2,773
1970	15,202	2,788	189	90	83	3,003	1,613	30.5	13.2	74.7	91,606	30,886	2,181	461	2,200

(a) Ref. 1, p.165

Table 6: Transportation and Communications in Iran

	Railroads km	Paved Road km	Gravel & Dirt Road km	Waterway km	Cars 10 ³	Commercial Vehicles 10 ³	Telephones 10 ³	Radios 10 ³	Television 10 ³
1965	3,499 (a)		23,497 (a)		135 (a)	47.5 (a)			
1966	3,499 (a)	8,243 (a)	24,653 (a)		142.5 (a)	49.2 (a)			
1967	3,509 (a)	9,517 (a)	23,961 (a)		164.2 (a)	59.7 (a)			
1968	3,509 (a)	10,148 (a)	24,983 (a)		191.7 (a)	53.4 (a)			
1969	3,509 (a)	11,063 (a)	26,116 (a)		254.3 (a)	64.5 (a)			
1970	4,412	11,322 (a)	28,019 (a)		278.2 (a)	73.5 (a)			
1971		11,400 (a)	31,303 (a)		331.2 (a)	79.6 (a)			
1972		12,060 (a)	31,382 (a)						
1973	3,818 (b)	11,398 (b)	31,296 (b)	1,013 (b)			307.5 (b)	1,800 (b)	260 (b)

(a) Ref. 1, p.159

(b) Ref. 2

Table 7: Energy Sources in Iran

SOURCE, In 10 ¹² kcalories		SOURCE, In %												
	Oil	Natural Gas	Coal	Hydro Electric	Charcoal, Wood, etc.	Nucl.	TOTAL	Oil	Natural Gas	Coal	Hydro Electric	Charcoal, Wood	Nuclear	
1960	47.9 ^d	25.6 ^d	1.58 ^d				82.5 ^b	67. ^b	31.1 ^b	1.9 ^b	0 ^b			1960
1961	52.3 ^d	25.6 ^d	1.36 ^d				87.35 ^b	69.1 ^b	29.3 ^b	1.6 ^b	0 ^b			1961
1962	38.4 ^a	9.9 ^a	1.4 ^a	.3 ^a	13.5 ^a		63.5 ^a	60.4 ^a	15.5 ^a	2.2 ^a	.7 ^a	21.2 ^a		1962
1963	47.9 ^d	26.3 ^d	1.10 ^d				82.77 ^b	66.8 ^b	31.8 ^b	1.3 ^b	0 ^b			1963
	54.6 ^d	26.6 ^d	1.33 ^d				90.96 ^b	69.2 ^b	29.3 ^b	1.5 ^b	0 ^b			
	41.46 ^c													
1964	67.1 ^d	30.1 ^d	1.89 ^d				109.38 ^b	70.8 ^b	27.5 ^b	1.7 ^b	0 ^b			1964
1965	87.7 ^d	30.3 ^d	1.89 ^d				133.48 ^b	75.8 ^b	22.7 ^b	1.4 ^b	0 ^b			1965
1966														1966
1967	65.8 ^a	12.9 ^a	1.7 ^a	2.4 ^a	8.5 ^a		91.3 ^a	72.3 ^a	14.1 ^a	1.8 ^a	2.6 ^a	9.2 ^a		1967
	67.79 ^c													
1969	78.72 ^c	25.50 ^f	3.37 ^{c+}	1.15 ^c			108.74 ^c	72.4 ^c	23.4	3.12	1.08			1969
	77.99 ^f													
1970	87.37 ^c	94.06 ^f	3.64 ^{c+}	1.44 ^c			186.52 ^c	47.17	50.4	1.95	0.48			1970
	86.11 ^f													
1971	96.57 ^f	80.69 ^f	4.10 ^{c+}	2.306 ^c			183.67 ^c	52.6	43.9	2.2	1.3			1971
	80.69 ^c													
1972	119.2 ^a	28.1 ^a	2.5 ^a	9.5 ^a	5.3 ^a		164.6 ^a	72.7 ^a	16.9 ^a	1.5 ^a	5.7 ^a	3.2 ^a		1972
	107.93 ^c	82.4 ^f	6.884 ^{c+}	3.36 ^c			200.6 ^c	53.8	41.2	3.44	1.56			
	105.98 ^f													

Table 7 (continued)

	SOURCE, In 10^{12} kcalories						SOURCE, In %							
	Oil	Natural Gas	Coal	Hydro Electric	Charcoal, Wood, etc.	Nuclear	TOTAL	Oil	Natural Gas	Coal	Hydro Electric	Charcoal, Wood	Nuclear	
1973	133.72 ^{e)}													1973
1974	152.62 ^{e)}													1974
1977	239.3 ^{a)}	98 ^{a)}	* -	19.7 ^{a)}	4.5 ^{a)}	-	361.5 ^{a)}	66.4 ^{a)}	27 ^{a)}	-	5.4 ^{a)}	1.2 ^{a)}		1977
1982	424 ^{a)}	243 ^{a)}	-	27.8 ^{a)}	-	65 ^{a)}	759.8 ^{a)}	55.8 ^{a)}	32 ^{a)}	-	3.7 ^{a)}	-	8.5 ^{a)}	1982
1987	629 ^{a)}	431 ^{a)}	-	55 ^{a)}	-	116 ^{a)}	1231 ^{a)}	51 ^{a)}	35 ^{a)}	-	4.4 ^{a)}	-	9.6 ^{a)}	1987
1992	748 ^{a)}	668 ^{a)}	-	110 ^{a)}	-	382 ^{a)}	1908 ^{a)}	39.2 ^{a)}	35 ^{a)}	-	5.7 ^{a)}	-	20.1 ^{a)}	1992

a) Ref. 7, p.72

c+) Ref. 6, p.19, includes solid fuels

f) Ref. 6 and calculations

b) Ref. 5, p.673

d) Ref. 5, p.638

* Coal is expected to be used in steel industries only (Ref.7)'

c) Ref. 6, p.19

e) Ref. 7, p. 38 and calculations

Table 8: Petroleum Use in Iran by Products

Year	Energy Values in 10 ¹² kcalories									
	Fuel Oils 10 ⁹ kg	Kerosene & Jet Fuel 10 ⁹ kg	Gasoline 10 ⁹ kg	Natural Gas 10 ⁹ m ³	LPG 10 ⁹ kg	All Gases 10 ⁹ m ³	Flared Gases 10 ⁹ m ³	Liquid Fuels	Natural Gas	LPG
1960						2.92 ^{g)}	4.59 ^{g)}			
1961						3.03 ^{g)}	6.20 ^{g)}			
1962								41.46		
1963		4.015 ^{h)}								
1964										
1965										
1966						4.0 ^{g)}	17.36 ^{g)}	67.79		
1967		6.565 ^{h)}								
1968										
1969	4.715 ^{a)}	1.915 ^{b)}	.923 ^{c)}	2.781 ^{d)}	.063 ^{e)}	6.174 ^{f)}		77.99	25.50	.72
1970	5.310 ^{a)}	1.974 ^{b)}	1.055 ^{c)}	10.258 ^{d)}	.110 ^{e)}	22.773 ^{f)}	18.77 ^{g)}	86.11	94.06	1.26
1971	5.970 ^{a)}	2.166 ^{b)}	1.216 ^{c)}	8.80 ^{d)}	.140 ^{e)}	11.75 ^{g)}		96.57	80.69	1.61
1972	6.393 ^{a)}	2.660 ^{b)}	1.210 ^{c)}	8.986 ^{d)}	.170 ^{e)}	19.536 ^{f)}		105.98	82.4	1.95
1973		12.950 ^{h)}				19.949 ^{f)}	28.23 ^{g)}	133.72 ^{h)}		
1974		14.78 ^{h)}				12.88 ^{g)}	27.84 ^{g)}	152.62 ^{h)}		

a) Ref. 6, p.127; b) Ref. 6, p.114; c) Ref. 6, p.103; d) Ref. 6, p.134 e) Ref. 6, p.93;

f) Ref. 6, p.144; g) Ref. 7, p.52; h) Ref. 7, p.38

Table 9: Total Electrical Power Installed and Electrical Energy Used in Iran

	Installed Power 10 ⁶ Kw						Total
	Thermal				Hydro- elec.	Nuclear	
	Steam Turb.	Gas Turb.	Dies. Eng.	Total			
1934	.006						.006 ^e
1960							
1961							
1962							
1963							.440 ^e
1964							
1965							
1966							
1967							
1968							.894 ^e
1969				1.616 ^f	.462 ^f		2.078 ^f
1970				1.680 ^f	.517 ^f		2.198 ^f
1971				2.007 ^f	.800 ^f		2.807 ^f
1972	.746 ^b	.172 ^b	.372 ^b	1.290 ^b 2.417 ^f	.804 ^b .900 ^f	--	2.094 ^b 3.317 ^f 3.35 ^c 2.851 ^h
1973				2.55 ^e	.804 ^e		
1974							
1977	2.65 ^b	2.36 ^b	.665 ^b	5.675 ^b	1.804 ^b		7.475 ^b
1982	11.07 ^b	2.30 ^b	.60 ^b	13.97 ^b	5.034 ^b	3.4 ^b	22.4 ^b
1987	17.9 ^b	4.0 ^b	.30 ^b	22.2 ^b	9.80 ^b	8.0 ^b	40.0 ^b
1992	24.0 ^b	6.0 ^b	--		20.0 ^b 10.0 ^c	20.0 ^b	70.0 ^b

- a. Ref 7, p.77
- b. Ref 7, p.63
- c. Ref 7, p.74
- d. Ref 7, p.48
- e. Ref 7, p.45,46
- f. Ref 6, p.153
- g. Ref 6, p.164
- h. Ref 2
- i. Ref 6, p.187
- j. Ref 5, p.673
- k. Ref 1, p.153

Notes: 1. About 90% of total electrical energy is produced by Ministry of power (7, p.60).
 2. In 1992 20% of total and 30% of electrical energy will be by nuclear energy.
 3. Data given by "f" seems to include "private" electricity product.

Table 9 (ctd): Total Electrical Power Installed and Electrical Energy Used in Iran

	Generated Energy, 10 ⁹ kWh							Total
	Thermal				Hydro-elect.	Nuclear	Others (Private)	
	Steam Turb.	Gas Turb.	Dies. Eng.	Total				
1934								
1960								2.010 ^j
1961								2.090 ^j
1962								2.150 ^j
1963								2.250 ^j
1964								2.300 ^j
1965								2.350 ^j
1966								
1967	.732 ^d	.056 ^d	.396 ^d	1.184 ^d	.658 ^d		2.291 ^d	4.133 ^d
1968								
1969				4.526 ^g	1.336 ^g			5.862 ^g
1970				5.372 ^g	1.671 ^g			7.043 ^g
1971				5.629 ^g	2.679 ^g			8.308 ^g
1972	2.513 ^d	.265 ^d	.564 ^d	5.189 ^g	3.528 ^d		2.683 ^d	9.553 ^d
				3.342 ^d	3.909 ^g			9.098 ^g
								10.17 ^h
1973	5.374 ^d	.541 ^d	.567 ^d	6.445 ^d	2.842 ^d		2.769 ^d	12.093 ^d
1974	6.545 ^d	.688 ^d	.511 ^d	7.744 ^d	3.421 ^d		2.840 ^d	14.005 ^d
1977	13.323 ^d	6.500 ^d	.900 ^d	20.723 ^d	7.218 ^d		2.964 ^d	30.905 ^d
1982	40.425 ^d	3.600 ^d	.500 ^d	44.525 ^d	11.437 ^d	26.402 ^d	3.272 ^d	85.686

Table 10: Uses of Electrical Energy by Various Sectors
(Sold by Ministry of Power)

	Total E.E. Generated 10 ⁹ kWh	Uses of Electrical Energy 10 ⁹ kWh					Ratio of Sale to Gen.	% of Uses of Electrical Energy											
		Residential	Commercial	Industrial	Agricultural	Street Lighting		Total Used	Residential	Commercial	Industrial	Agricultural	Street Lighting						
1965																			
1966																			
1967	1.842 ^b	.473 ^a	.324 ^a	.504 ^a	.033 ^a	.127 ^a	1.461 ^a	.77	32.4	22.2	34.5	2.2	8.7						
1968																			
1969																			
1970																			
1971	6.870 ^b	1.218 ^a	1.296 ^a	2.745 ^a	.141 ^a	.323 ^a	5.723 ^a	.83	21.3	22.6	48.0	2.5	5.6						
1972	9.324 ^b	3.354 ^a	5.474 ^a	14.605 ^a	.748 ^a	.687 ^a	24.868 ^a	.89	13.5	22.0	58.7	3.0	2.8						
1973	11.165 ^b	10.292 ^a	14.771 ^a	39.868 ^a	1.965 ^a	1.109 ^a	68.005 ^a	.83	15.1	21.7	58.6	2.8	1.8						
1974																			
1975																			
1976	27.941 ^b																		
1977	82.364 ^b																		
1982																			

a. Ref 7, p.63; b. Ref.7, p.48.

Notes: Electricity generated by private industries and some municipalities is not included in this table.

Table 11: The Gross Domestic-and Gross National-Products

	Value Added by Major Sectors				Gross National Product		Shares in GDP by Sectors (%)				
	Agriculture \$10 ⁹	Oil \$10 ⁹	Indus-tries & Mines \$10 ⁹	Services \$10 ⁹	Total (GDP) \$10 ⁹	GNP \$10 ⁹	Per Capita GNP \$	Agricul- ture	Oil	Indus- tries & Mines	Services
1965											
1966											
1967						10.16 ^b	383.4 ^b	24.5 ^d	13.8 ^d	21.3 ^d	40.4 ^d
1968											
1969											
1970											
1971	2.98 ^a					14.2 ^c	460 ^c				
1972		3.20 ^a	3.66 ^a	6.60 ^a	16.44 ^a	17.26 ^b	566 ^b	18.1 ^d	19.5 ^d	22.3 ^d	40.1 ^d
1973											
1974											
1975											
1976	4.18 ^a	25.26 ^a	8.38 ^a	14.13 ^a	52.05 ^a	54.61 ^b	1521 ^b	8 ^d	48.7 ^d	16.1 ^d	27.2 ^d
1977						33.4 ^e	851 ^e				
1978											

1. GDP stands for gross domestic products

2: The figures are based on 1972 dollars

a. Ref 10, p.3; b. Ref 10, p.2; c. Ref 2; d. Ref 10, p.4; e. Ref 3.

Table 12: Per Capita Energy Consumption and the Gross National Product

	Population 10 ⁶	Total Energy Used		Elec. Energy 10 ⁹ kWh	Per Capita		
		10 ¹² KCal	10 ⁹ kWh		Total kWh/yr	Elec. kWh/yr	GNP \$
1962	22.77	63.5 ^a	73.85		3,243	101 ^c	
1965	24.87						
1966	25.08						
1967	26.8	91.3 ^a	106.18	4.133 ^b	3,962	154	383.4
1968	27.6						
1969	28.4					210 ^d	
1970	29.25					246 ^d	
1971	30.16					279 ^d	460
1972	31.095	164.6 ^a	191.31	9.553 ^b	6,152	307.2 298 ^d	566
1973	32.075						
1974	33.085 ^e						
1975	34.128 ^e						
1976	35.203 ^e						
1977	36.312 ^e	361.5 ^a	420.42	30.905 ^b	11,578	851.1	1521
1982	42.20 ^e	759.8 ^a	883.64	85.636 ^b	20,840	2019	
1987	49.51 ^e	1231 ^a	1431.65		28,916		

a. Ref 7, p.72; b. Ref 7, p.48

c. Ref 5, p.673; d. Ref 6, p. 187

e. Estimated with an increase rate of 3.15%

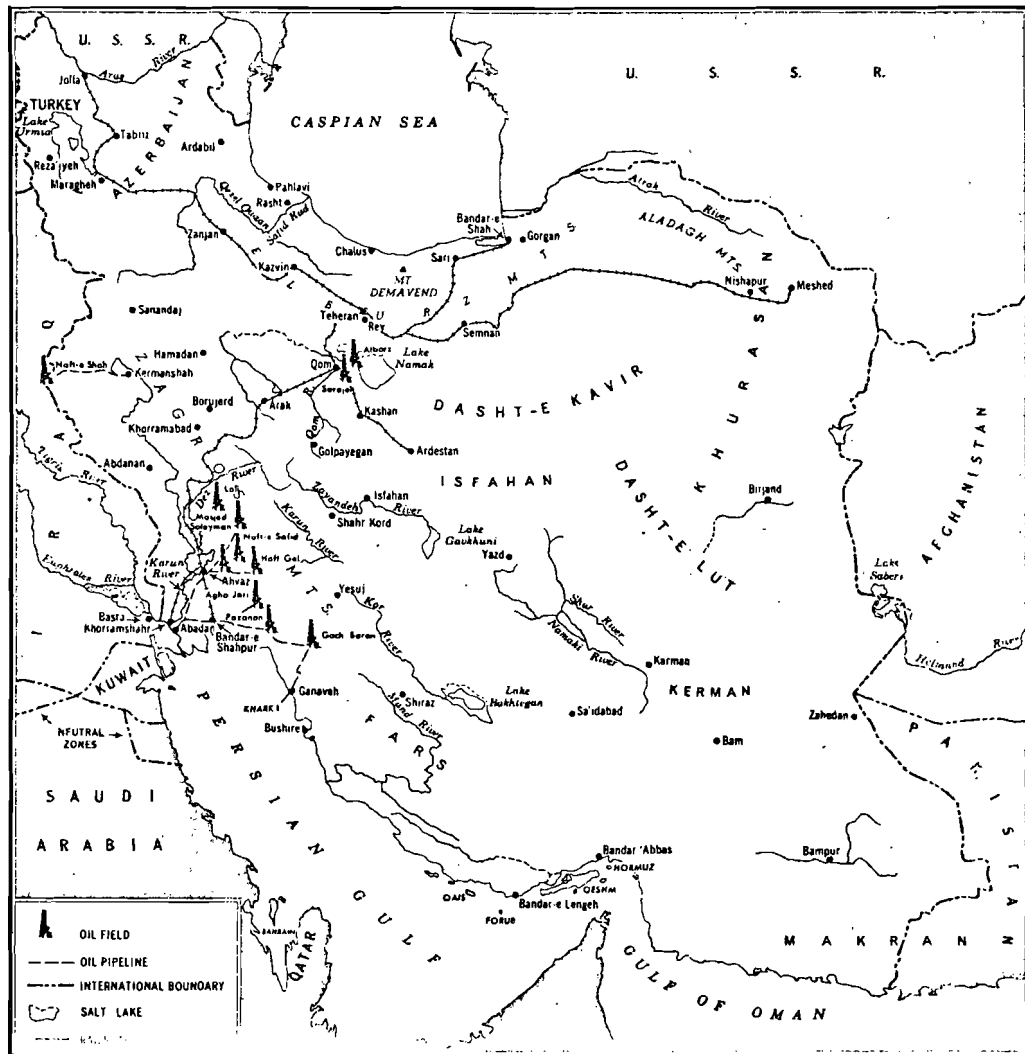


Figure 1: Principal Towns, Oil Fields, Pipelines, and Railroads in Iran

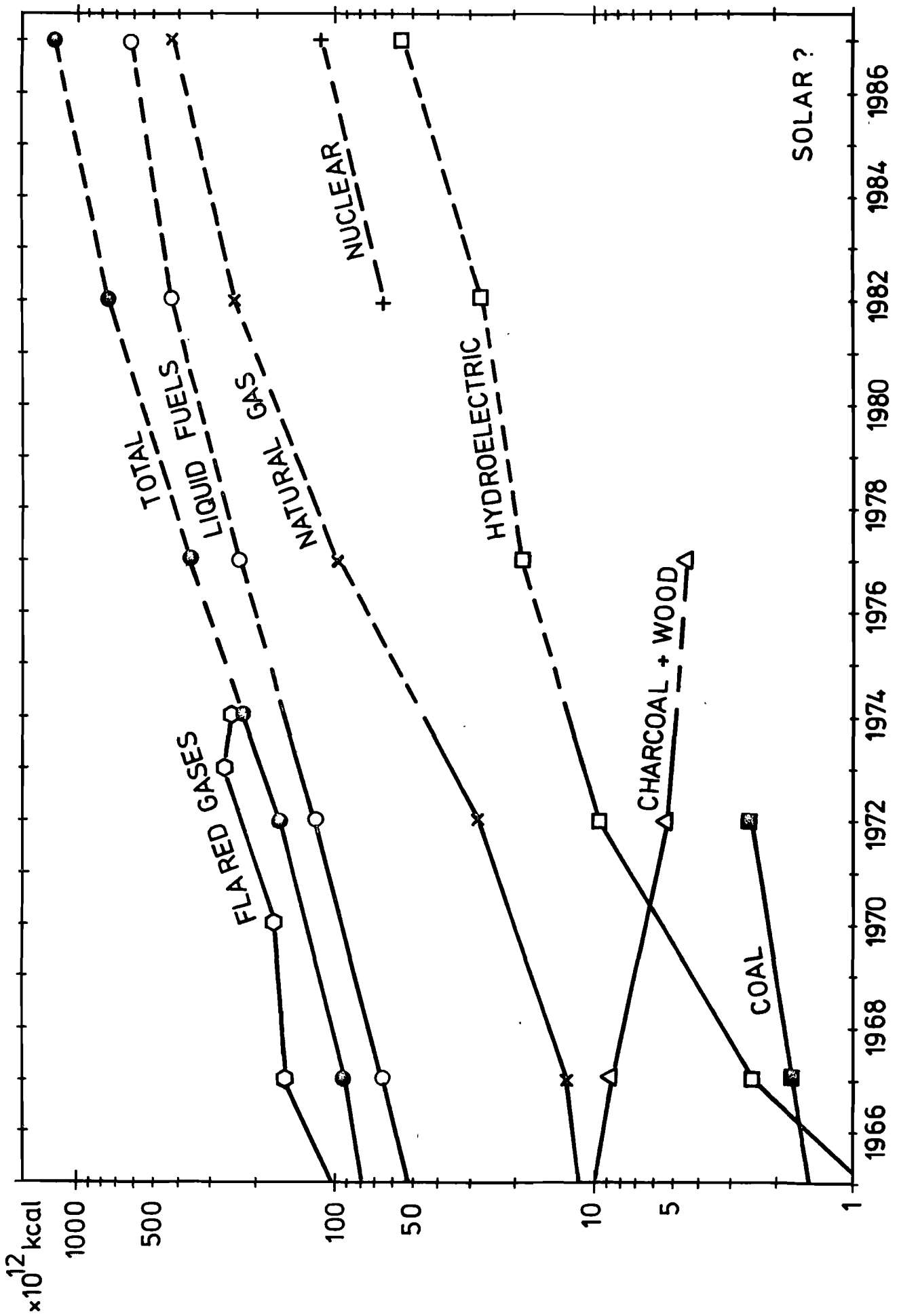


Figure 2: Energy Sources

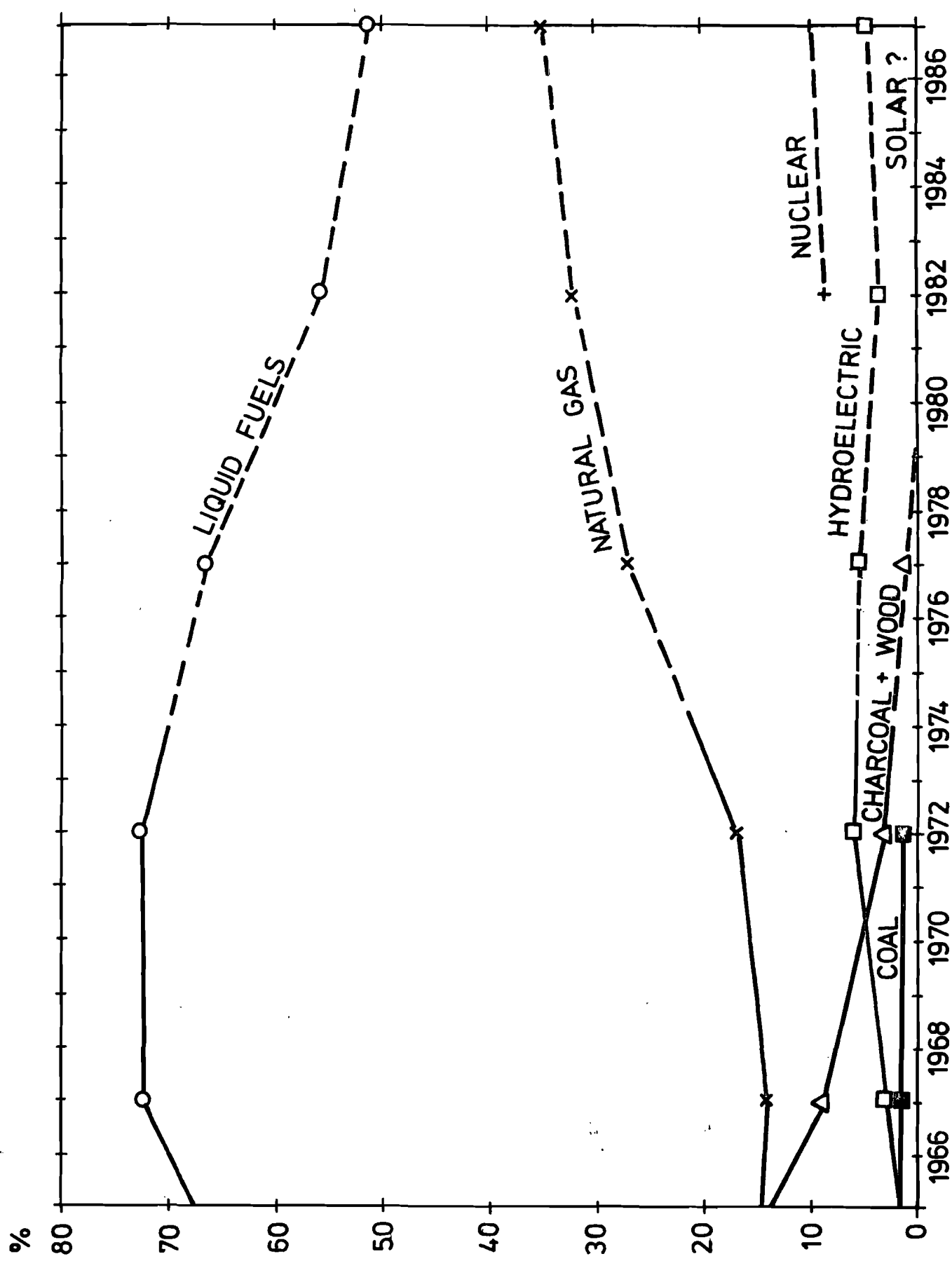


Figure 3: Energy Sources by % of Energy Values

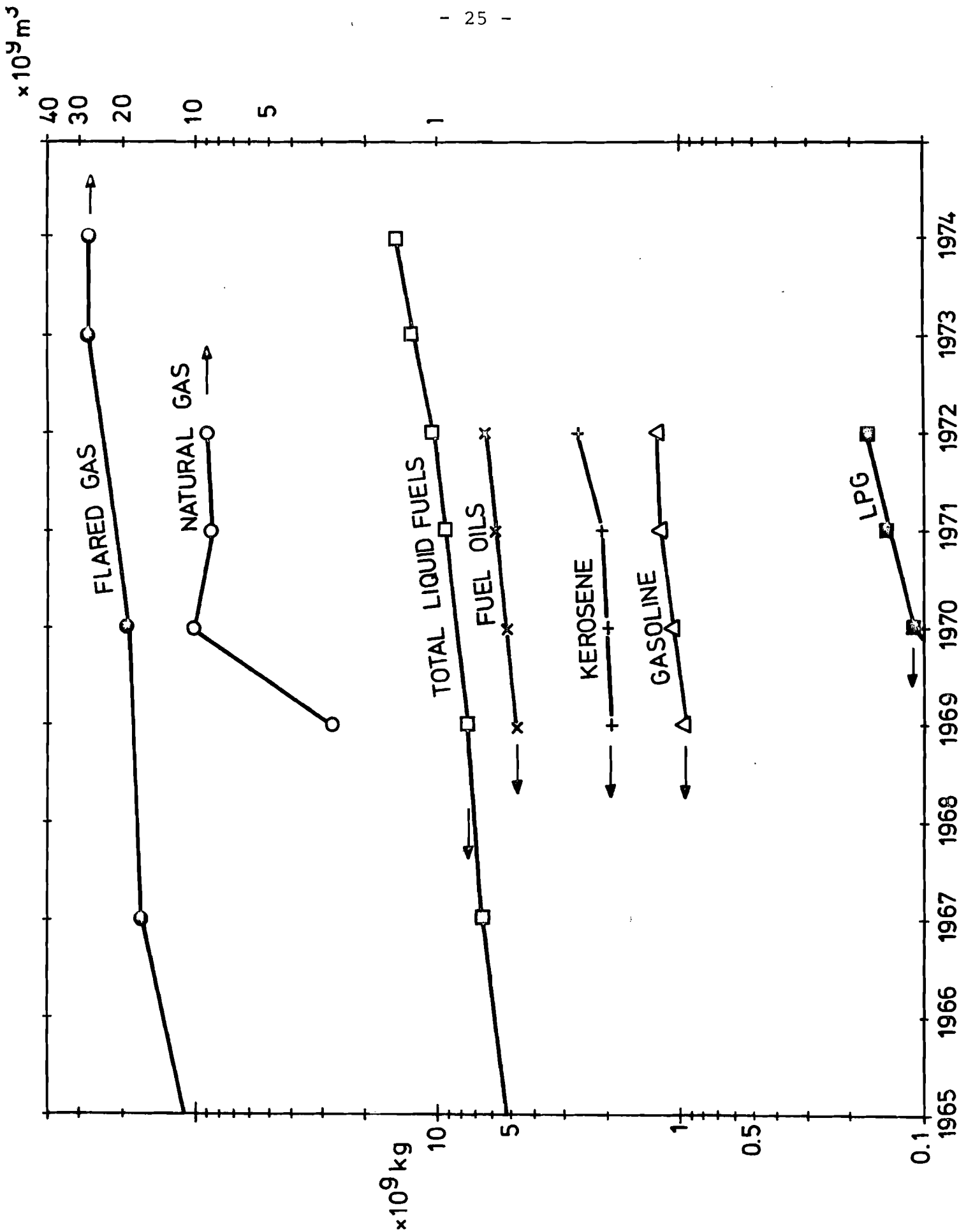


Figure 4: Petroleum Uses by Products

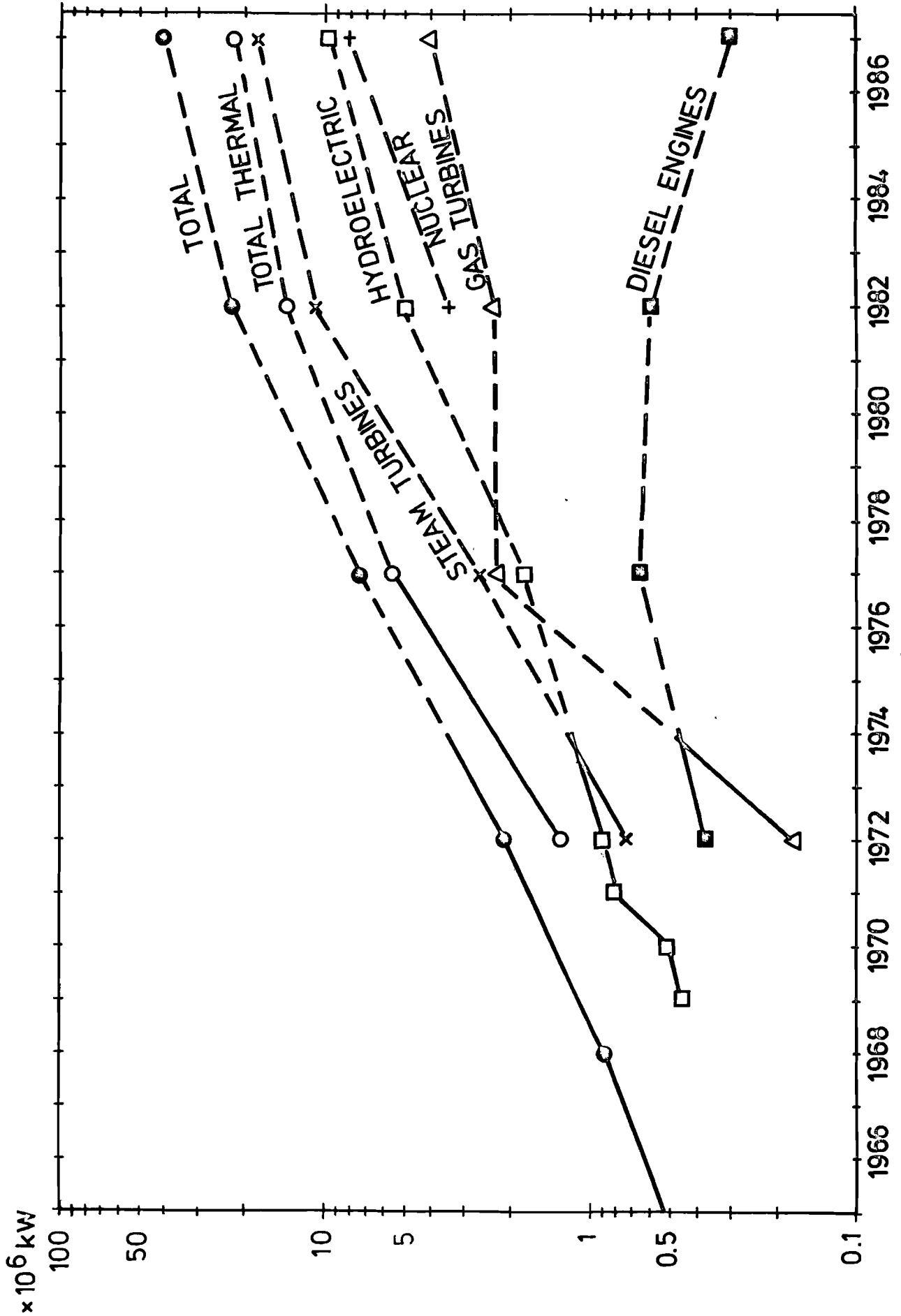


Figure 5: Installed Power for Electrical Energy Generation

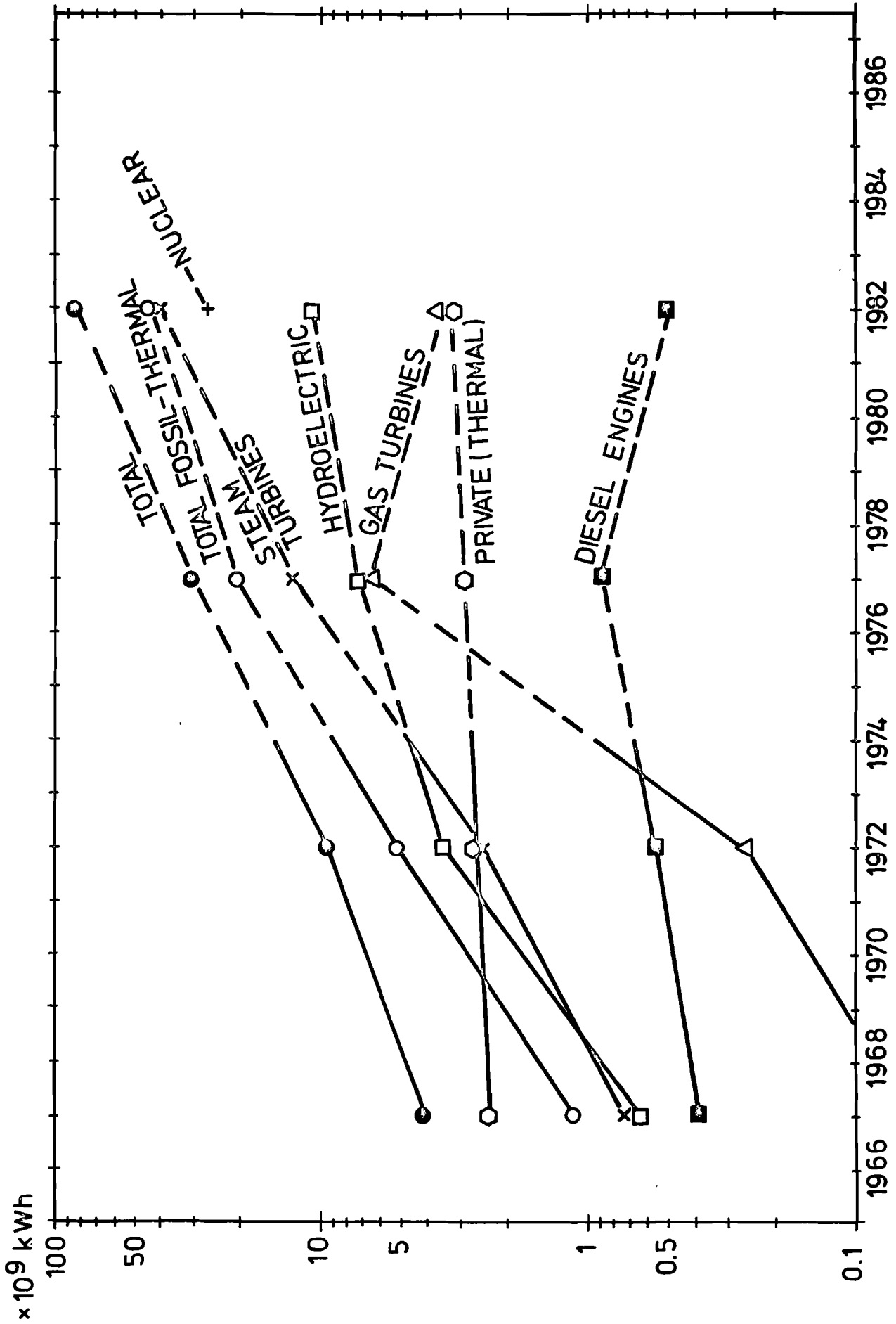


Figure 6: Electrical Energy Generation

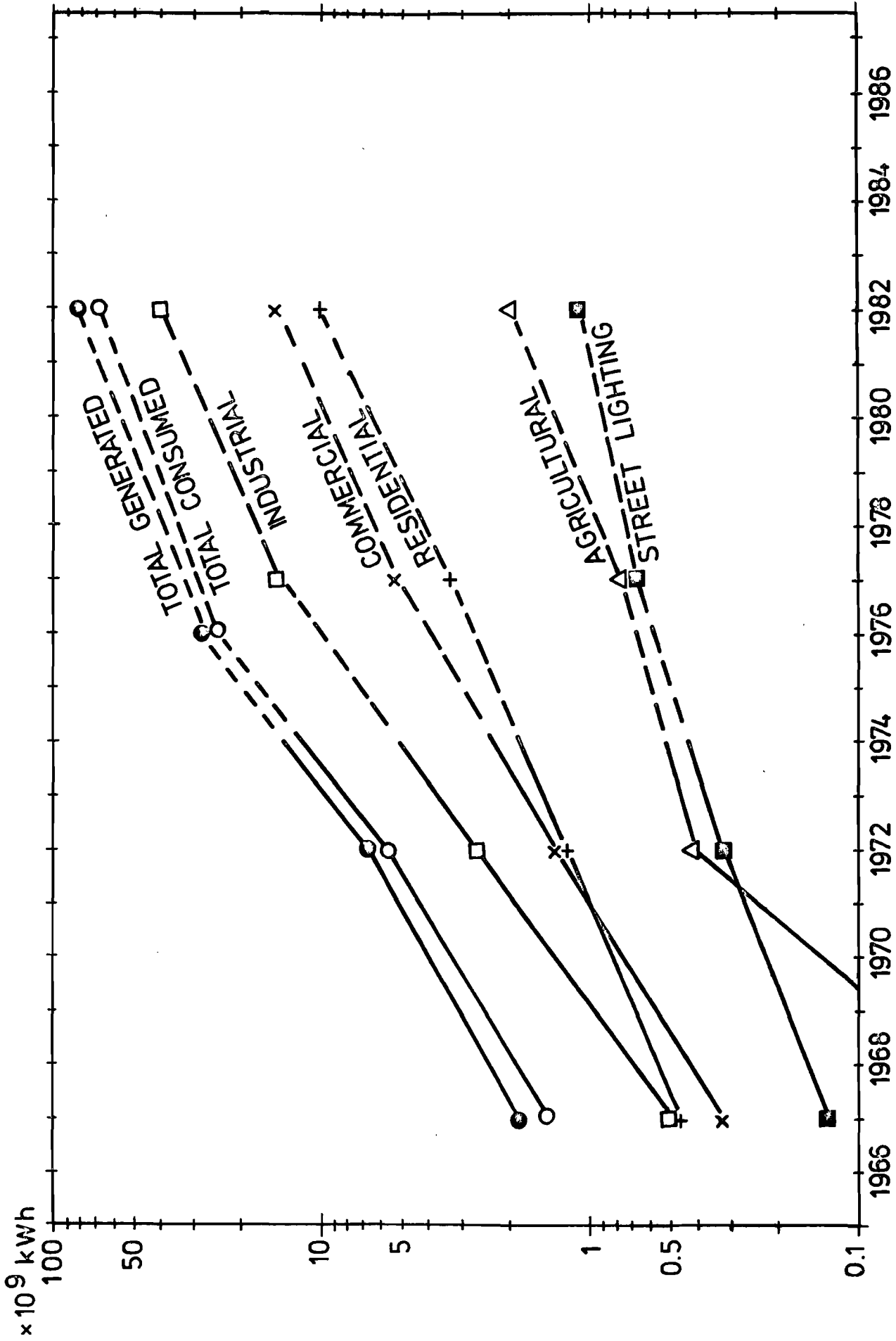


Figure 7: The Uses of Electrical Energy Generated by the Ministry of Power by Various Sectors

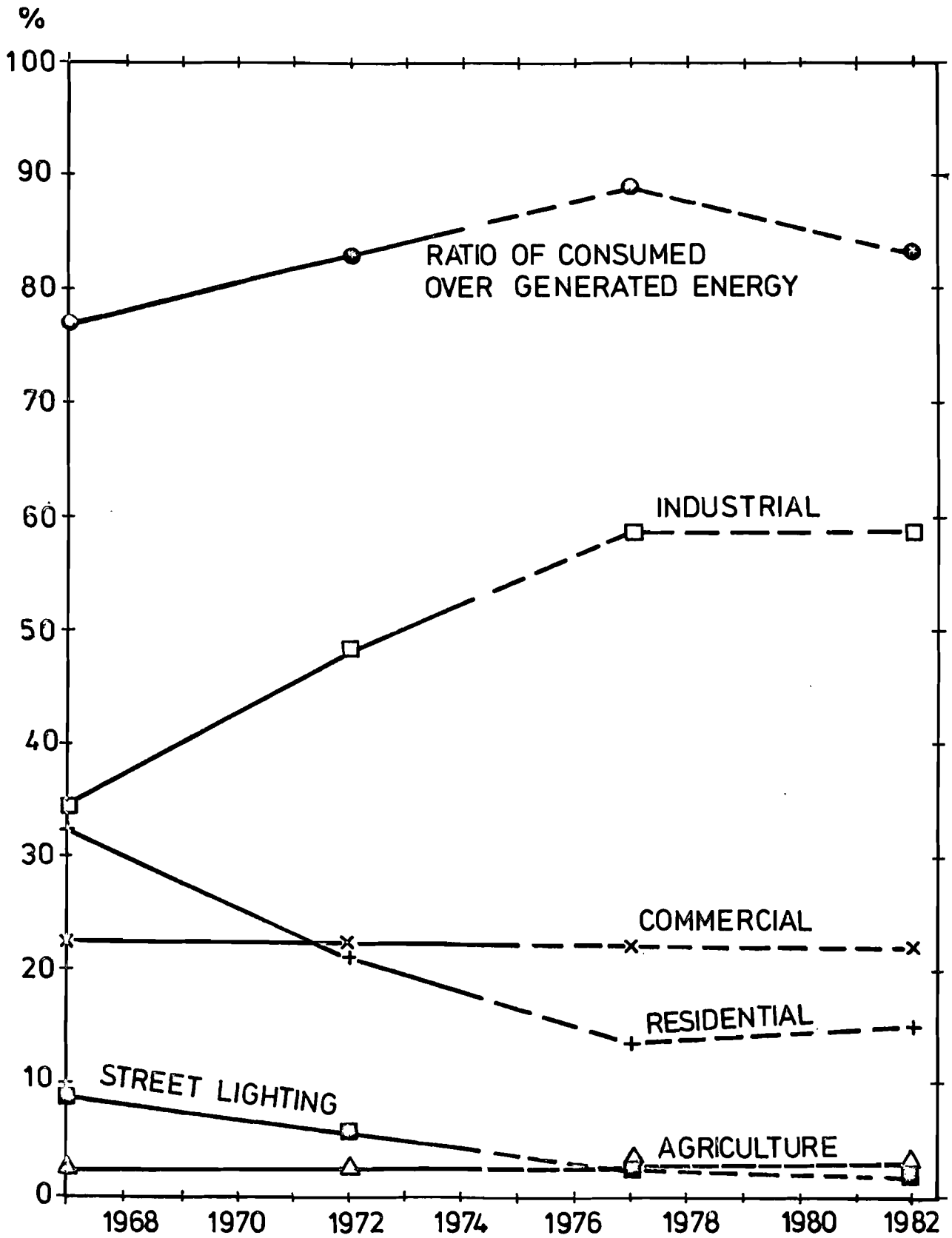


Figure 8: Distribution of Electrical Energy Generated by Ministry of Power among Various Sectors

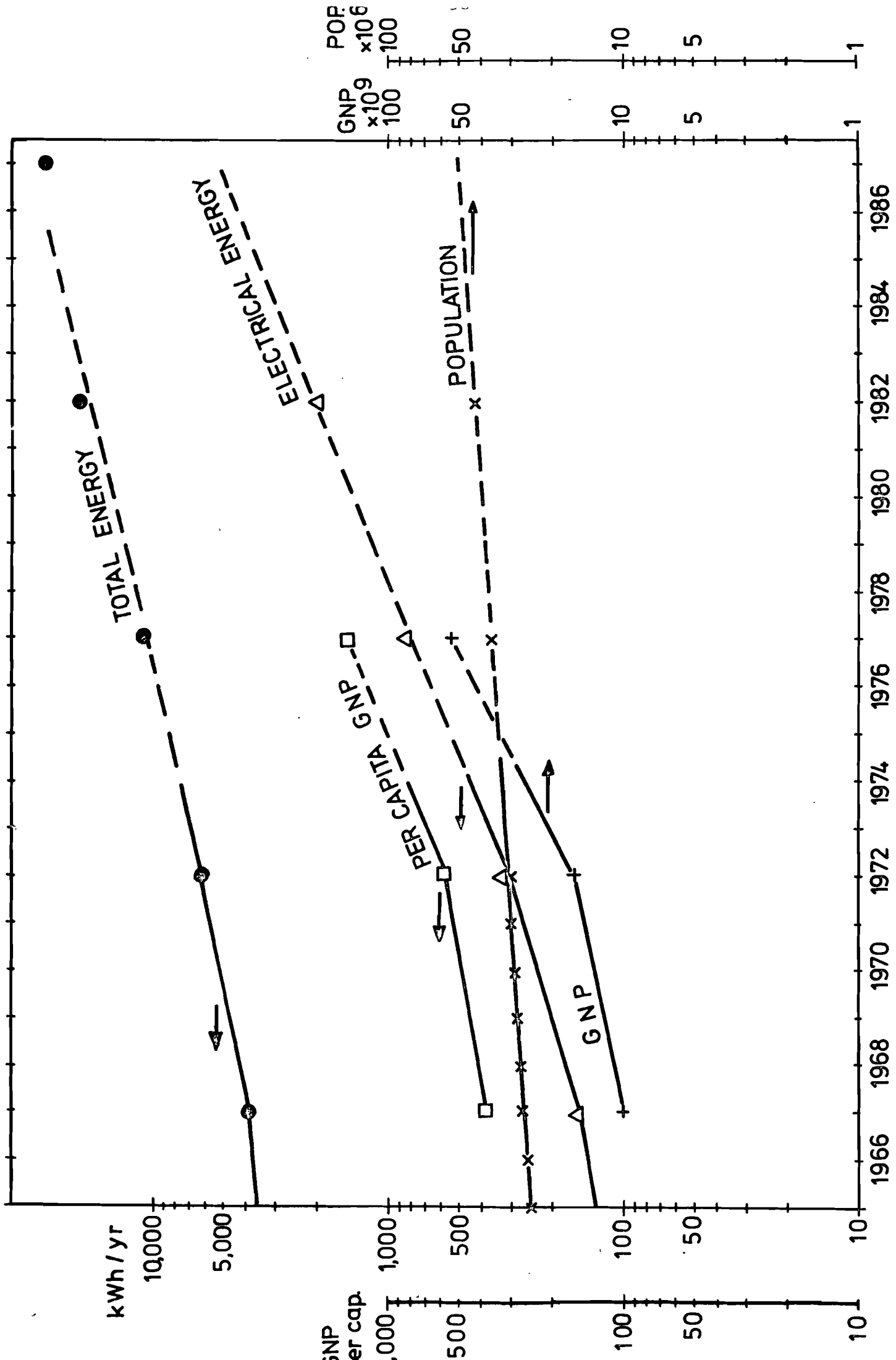


Figure 9: Per Capita Energy Consumption & the Gross National Product