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FOR REFERENCE

NOT TO BE TAKEN FROM THIS BUILDING

THE PRESENT COMPARATIVE POSITIONS OF FUEL-OIL
AND COAL IN THE CENTRAL HEATING OF APARTMENT
BUILDINGS IN ISTANBUL

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Chapter I

Introduction and Methodology

A. Introduction

1. Subject

The subject of this thesis is: "The present comparative positions of fuel-oil and coal ^{1/} in the central heating of apartment buildings in İstanbul".

2. Nature of and limits of the subject:

Fuel-oil and coal are the two principal sources of heat energy utilized in central heating of apartment houses in Turkey. Of the two coal has the longer history in Turkey. It dates from the turn of the century with the discovery and exploitation of the anthracite deposits in the Ereğli region on the Black Sea and the lignite deposits at Soma in western Anatolia. Fuel-oil, as compared to coal, is a new product. It entered the market in 1962 and made rapid progress. This quick success was due both to the advantages of fuel-oil as a source of heat and to the fact that anthracite, the highest grade of coal, is in short supply. The deposits at the Ereğli mines are being rapidly depleted and the government is restricting use to the nationalized transportation industry.

Today two classes of products compete in the domestic fuel market: (1) Solid fuels (e.g., lignite, wood, dung)

(2) Liquid fuels (e.g., fuel-oil)

Electric heating supplements these to a very limited extent. ^{2/} Liquid petroleum gas (LPG) and natural gas are not used at all for central heating of apartment houses in İstanbul ^{3/}

^{1/} The term "coal" is used for anthracite and lignite collectively. In those cases where a separate designation is required it will be so noted.

^{2/} Seminar proceedings: Türkiye'de Yakıt Problemi ve Hal Çareleri pp. 133

^{3/} İbid p. 105

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The temperate climate of İstanbul makes solar heating a potential competitor; however, as of now no serious consideration is being given to this source of heat. Other potential competitors in the longer run are those mentioned earlier, namely, electricity, LPG, and natural gas. These potential competitors are not important market factors today and so are excluded from this study.

Other factors which have helped narrow down the study to coal and fuel-oil in present-day apartment houses in İstanbul include the following items:

(1) Wood and dung were eliminated because they are primitive fuels and are completely inadequate for use in a central heating system.

(2) Private houses were excluded because only five per cent have central heating.

(3) Apartment houses were selected as a basis because sixty per cent of those constructed in the 1960's included some form of central heating. ^{1/}

(4) İstanbul was selected as the market because of convenience and because it was considered to be a representative sample of the national market.

3. Nature of the data used:

The quantitative data of the thesis is inadequate at many points. This is due to the following reasons:

a. Companies are reluctant to divulge information about pricing and advertising policy and market shares. These companies, mostly those in the fuel-oil market, feel that it would work to their disadvantage if competing firms secured any information about their operations.

^{1/} Neyzi, N., unpublished research.

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b. There is a great amount of red tape involved in getting information from the government and what information is available is inadequate. The State Statistical Institute has no statistics on the number of centrally-heated dwellings in any part of Turkey. The municipality of Istanbul does have this information but does not publish a statistical abstract dealing with the subject and does not permit access to the archives where such information is kept.

B. Sources of information and methodology

This study is based on information secured from personal interviews with officials of various public and private organizations.

These included the following:

- (1) Fuel-oil wholesalers
- (2) Fuel-oil retailers
- (3) Sellers of oil heating equipment
- (4) Sellers of fuel-oil burners
- (5) Government agencies:
 - (a) Ministry of Energy and Natural Resources.
 - (b) State Planning Organization
 - (c) Ministry of Housing and Building
 - (d) State Statistical Institute
- (6) Türkiye Kömür İşletmeleri (TKİ)
- (7) Türkiye Kömürleri A.Ş.

The following is a summary of the more important items of information listed according to source:

- (1) Wholesalers of fuel-oil:
 - a. Technical properties of fuel-oil.
 - b. Market structure of fuel-oil.

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- c. Basic price of fuel-oil
- d. Lists of names of fuel-oil retailers
- e. Hourly fuel oil needs of apartments.
- (2) Retailers of fuel-oil:
 - a. Wholesaler-retailer relations.
 - b. Retailer-consumer relations.
 - c. Growth of the Istanbul fuel-oil Market.
- (3) Sellers of fuel-oil burners:
 - a. Costs of converting from coal to fuel-oil.
 - b. Growth of the Istanbul fuel-oil market.
- (4) Ministry of Energy and Natural Resources:
 - a. Relationships among agencies in the state sector.
- (5) State Planning Organization:
 - a. Statistics of raw petroleum imports.
- (6) Türkiye Kömür İşletmeleri:
 - a. The major portion of the data about coal in Turkey.
- (7) Türkiye Kömürleri A.Ş.
 - a. Information about the private sector of Istanbul's coal market.

Disappointingly no useful information was obtained from the Ministry of Housing and Buildings.

C. Outline of the Thesis

This thesis consists of four chapters. The first chapter provides an introduction and indicates the methodology used. The second chapter compares fuel-oil to coal in terms of heat supplied per Turkish lira and includes a study of the cost of converting a coal system to fuel-oil. The third chapter contains a description and an analysis of the fuel-oil and coal markets. The last chapter has a discussion of the growth characteristics of the fuel-oil market and ends with some conclusions.

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Chapter II

Fuel Oil and Coal Compared

Limits of the chapter:

This chapter is confined to a comparison of fuel oil and coal as sources of heat energy in multi-unit dwellings with central heating.

I- Nature of the two commodities:

Fuel Oil: By-product of petroleum fuel oil is chemically classifiable as a hydro-carbon. It is graded into three categories according to the length of the hydro-carbon chain.

Table 1 ^{1/}

Properties of Fuel Oil

<u>Fuel Oil</u>	<u>A. Light</u>	<u>B. Medium</u>		<u>C. Heavy</u>
Grade No:	4	5		6
		5a	5b	
Pour Point (Liquid)	+2 C	+10C	+15C	+20 C
Firing point (Liquid)	+66 C	+66C	+66C	+66 C
Ash content	.02	.05	.1	.1
Heat value (Kcal/Kg) ^{2/}	10 790	10 600	10 400	10 300

Two things should be noted with respect to the above table: First, different pour points for each of the grades of fuel oil necessitates pre-heating whenever grades 5b and 6 are utilized.

1/ Mobil Oil: Fuel Oil Quality.

2/ A Kilogramme-Calorie (Kcal) is the quantity of heat needed to raise one kilo of water from 4 C to 5 C. The term Kcal/Kg shows the number of Kcals the fuel has per Kg.

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As the former is widely used in home heating an increase in the costs of usage results. Second, a common denominator may be said to exist between the different grades of fuel oil in terms of heat value in Kcal/Kg's. This is because the heat value of fuel oil 4 is only 4.5% higher than the heat value of fuel oil 6 taking the latter as a base. This can be considered as of minor importance.

Anthracite and lignite: Unlike fuel oil which is a processed product, these are natural products which are utilized in their original solid form.

Table II
Properties of Anthracite and Lignite 1/

<u>Product</u>	<u>Kcal/Kg</u>
Anthracite	7 000
Lignite 1	5 600
Lignite 2	5 200
Lignite 3	4 500
Lignite 4	4 000

As is indicated above large differences in heat value exist among different grades of coal with anthracite supplying 75% more Kcal/Kg as compared to Lignite 4 and Lignite 1 supplying 40% more Kcal/Kg than Lignite 4.

II- The problem of efficiency. 2/

Due to technical reasons a fuel oil furnace operates at .75 efficiency while the efficiency of a coal burning furnace is .35; i.e. in a fuel oil burning system .75 of the heat values supplied as inputs are obtained as outputs whereas in coal burning systems only .35 of the inputs are obtained as outputs. 3/

-
- 1/ Ereğli Kömür İşletmeleri: Kömür üzerine rapor. (Report on Coal)
 - 2/ This information originally given by Mobil Oil was corroborated by the E.K.İ.
 - 3/ These are only average figures. Each tank may vary in either direction from these. These variations are small and are usually disregarded by the dealers in their calculations for "there are as many variations as there are tanks."

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These figures are applicable to systems without either thermostatic controls for fuel oil or temperature regulators for coal. The use of these control mechanisms increases efficiency by reducing waste. But because thermostatic controls are more sensitive than temperature regulators a greater increase in efficiency results in fuel oil burning system. 1/

III-Comparison of the two commodities as sources of heat.

A. Relationship among heat values in terms of cost.

Because Kcal/Kg and Price/Kg in TL . of the two commodities are known Kcal/ TL . can be obtained by dividing the former figure by the latter.

Table III

Kcal/ TL . of Coal and Fuel Oil 2/

<u>Input</u>	<u>Kcal/Kg</u>	<u>Price/Kg</u>	<u>Kcal/TL.</u>
Fuel Oil 4			
with tax	10 790	.67 <u>3/</u>	16,104
without tax	10 790	.50	21,580
Fuel Oil 5a	10 600	.39	27,179
" " 5b	10 400	.347	29,971
" " 6	10 300	.308	33,442
Anthracite	7 000	.14 <u>4/</u>	50,000
Lignite 1	5 600	.20	28,000
" 2	5 200	.18	28,889
" 3	4 500	.12	37,500
" 4	4 000	.11	36,364

- 1/ The exact figures for the increase in efficiency when regulating devices are used are not available.
- 2/ Source: Mobil Oil. (These are the base prices, ^{of Fuel Oil} market prices are unavailable due to competitive reasons,) E.K.I.
- 3/ The high cost of fuel oil 4 to the consumer results from a high production tax levied on this particular grade (34% of base price). Because fuel oil is a joint product the tax has little effect on production. The two sets of figures are included for purposes of comparison. Social implications of the policy are outside the scope of this study. However, it may be added that since the government is the main consumer of this grade of fuel oil the effect is an intra-government one.
- 4/ Anthracite is under a government monopoly with an administered price. Thus the low price is a subsidy to the industrial sector of the economy.

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B. Heat Supplied

The quantity of heat supplied to central heating systems (sans temperature regulators) can be calculated by multiplying the figures of the last column in Table III by the efficiency figures noted in Section II.

Table IV
Actual Heat Supplied
(with no temperature regulators)

<u>Input</u>	<u>Kcal/L.</u>	<u>X</u>	<u>Efficiency</u>	<u>= Actual heat supplied Kcal/L.</u>
Fuel Oil 4				
with tax	16 104		.75	12,078
without tax	21 580		.75	16,185
Fuel Oil 5a	27 179		.75	20,384
" " 5b	29 971		.75	22,478
" " 6	33 442		.75	25,082
Anthracite	50 000		.35	17,500
Lignite 1	28 000		.35	9,800
" 2	28 889		.35	10,111
" 3	37 500		.35	13,125
" 4	36 364		.35	12,727

The data of the table above indicates that with the given prices fuel oil of types 5a, 5b and 6 have a clear advantage over coal. On the other hand, fuel oil 4 is at a disadvantage as compared with high grade anthracite. This disadvantage holds even when the price of fuel oil 4 is taken net of "production tax". As mentioned earlier this is due to the artificially set low price of anthracite.

C. Price variations

The main factors underlying the above analysis are: quantity of heat supplied per kilogram, efficiency of the heating unit, and

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the price of the fuel used. Of the three, the first two are purely technological factors and are completely independent of the workings of the market mechanism in the short run. 1/ However, the last factor, price of the fuel used, is reached via the market mechanism. 2/

The following analysis will determine the indifference price of the two commodities; i.e., if operating costs are disregarded, the point where the Kcal/ℓ. of each of the commodities is the same. This will be done in two ways: (a) the price of coal will be kept constant while the price of fuel oil will be varied; (b) the price of fuel oil will be the constant and the price of coal will be treated as the variable.

a. Coal prices constant, fuel oil prices variable.

The problem is to determine the maximum level to which fuel oil prices can rise for a point of indifference to be reached with coal. Here anthracite price will be held constant and fuel oil price will be varied

Given an anthracite price of 14 ℓ/Kg, the heat supplied per kg. is 7,000 Kcal (see Table II); consequently, the heat supplied in terms of Kcal/ℓ. equals $\frac{\text{Kcal/Kg} \times \text{efficiency}}{\text{Price/Kg}}$. Since Kcal/Kg x efficiency is constant for the different fuels, the numerator of the equation can be written in the form of Kcal/Kg x efficiency = C. Hence heat supplied (Kcal/Kg) = C/(Price/Kg). The constant C has a different value for each grade of fuel.

-
- 1/ In the long run research initiated by the coal companies may result in an increase of the technological efficiency of the tanks so as to put coal in a more favourable position as compared to fuel oil; however, there are no indications of a move in that direction at present.
 - 2/ Fuel oil prices unlike the prices of other petroleum products are entirely determined by market forces.

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Table V
The Values of C_f for Fuel Oil.

<u>Input</u>	<u>Kcal/Kg</u>	<u>X</u>	<u>Efficiency</u>	=	<u>C</u>
Fuel Oil 4	10 790		.75		8 092
" 5a	10 600		.75		7 950
" 5b	10 400		.75		7 800
" 6	10 300		.75		7 725

For the determination of the indifference points (prices) of fuel oil and coal H_c (heat supplied by coal) will be used instead of H in the equation $H = C/P$; for C the figures calculated in Table V. will be used. The equation will then be solved for P . The value of P obtained through this method will show the level to which fuel oil prices must rise (fall in the case of fuel oil 4) in order for an indifference price to be reached with coal. Above this price the use of coal in heating will be more advantageous to the consumer.

Example: Comparison of fuel oil 4 with anthracite.

Fuel oil 4 $C = 8\ 092$ Price (Basic including tax) = $.67$ ₺./Kg

Anthracite Heat supplied = $17\ 500$ Kcal/₺.

$H_c = C_f/P$ in numerical form: $17\ 500 = 8\ 092/P_{f4}$ $\frac{1}{}$

Solving for P_{f4} . $P_{f4} = .46$ ₺./Kg.

The market price of this grade of fuel oil is $.67$ ₺./Kg (including "Production Tax") hence the prices of fuel oil 4 should be reduced by at least $.21$ ₺./Kg to make it competitive with Anthracite. Assuming that the extra burden of "production tax" is lifted, a differential of $.03$ ₺./Kg still exists in favour of anthracite.

 $\frac{1}{}$ The subscripts "f" and "c" show whether the relevant figure is for fuel oil f or coal.

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The analysis can best be summarized in tabular form.

Table VI a

The Indifference Prices of Anthracite and Fuel Oil when Fuel Oil Prices are taken as Variable

Fuel	(1) Price/Kg <u>Market or basic</u>	(2) Indifference price. (₺./Kg)	(3) (1)-(2) Margin of differ- ence (₺./Kg)
Anthracite	.14	-	-
Fuel Oil 4			
with tax	.67	.46	-.21
without tax	.50	.46	-.04
Fuel Oil 5a	.39	.454	.064
" " 5b	.347	.446	.099
" " 6	.308	.441	.133

As is indicated above a rather wide range of comparative advantage exists among fuel oils and anthracite; the advantage being with fuel oil in all cases except grade 4. Even in this case it should be borne in mind that (1) anthracite prices are kept artificially low by government intervention; (2) anthracite is by and large unavailable for public consumption for heating purposes.

The next step is a comparison with Lignite 3, which gives the most Kcal/₺. in the lignite group, with fuel oil.

Table VI b

Indifference Prices of Lignite 3 and Fuel Oil with Fuel Oil Prices

Fuel	(1) Price/Kg <u>Market or Basic</u>	(2) Indifference price. (₺./Kg)	(3) (1)-(2) Margin of differ- ence (₺./Kg)
Lignite 3	.12	-	-
Fuel Oil 4			
with tax	.67	.616	-.054
without tax	.50	.616	.116
Fuel Oil 5a	.39	.606	.216
" " 5b	.347	.594	.247
" " 6	.308	.589	.281

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The table above shows that the margins of safety with respect to price increases are noticeably wider when lignite 3 is taken as the base of analysis. The disadvantage of fuel oil 4 disappears when prices net of tax are considered.

b. Fuel oil prices constant, coal prices variable.

The problem now is "How much do coal prices have to be reduced to make coal competitive with fuel oil in terms of price?"

The method to be followed is parallel to that previously used.

Table VII
Calculation of C_c for Coal

<u>Input</u>	<u>Kcal/Kg</u>	X	<u>Efficiency</u>	=	<u>C</u>
Anthracite	7 000		.35		2 450
Lignite 1	5 600		.35		1 960
" 2	5 200		.35		1 820
" 3	4 500		.35		1 575
" 4	4 000		.35		1 400

In determining the points of indifference the formula developed earlier (see pp. 5, 6) will be used in the form $H_f = C_c/P$. The result of the calculations in tabular form are as follows:

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Table VIII a 1/

Fuel Oil 4 Prices Constant, Coal Prices Variable. (3)

Fuel	(1) Price/Kg Market or basic	(2) Indifference Price (₺./Kg)	(1)-(2) Margin of difference ce (₺./Kg)
Fuel Oil 4			
with tax	.67		
without tax	.50	-	-
Anthracite	.14	.203 .151	-.063 -.011
Lignite 1	.20	.162 .121	.038 .079
Lignite 2	.18	.151 .112	.029 .068
Lignite 3	.12	.130 .097	-.010 .023
Lignite 4	.11	.116 .086	-.006 .024

Taking fuel oil 5a as the basis of comparison we obtain the following table:

Table VIII b

Fuel Oil 5a Prices Constant, Coal Prices Variable.

Fuel	(1) Price/Kg Market or basic	(2) Indifference Price (₺./Kg)	(1)-(2) Margin of difference (₺./Kg)
Fuel Oil 5a	.39	-	-
Anthracite	.14	.120	.020
Lignite 1	.20	.096	.104
" 2	.18	.089	.091
" 3	.12	.077	.043
" 4	.11	.069	.041

1/ Figures in the lower lines show what the margin of difference is without the production tax on this grade of fuel oil.

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Conclusions: The weakness of the above analysis lies in the fact that base prices (as noted in Table III) were used for fuel oil while actual market prices were used for coal. However, the conclusions reached are unaffected by this because it is fuel oil which is most advantageous pricewise; consequently, with base price subject to discounts 1/ the advantage is increased with each such deduction from basic price. The main conclusion of the above analysis is that fuel oil possesses a great advantage over coal as a source of heat energy. The one exception is that of anthracite which holds an advantage over fuel oil 4. But even here there is some doubt. In the computations above fuel oil 4 was adjusted for "production tax". On the other hand, there was no comparable adjustment for the lack of a true market price for anthracite - one determined solely by demand and supply factors. It is highly probable that such an additional adjustment would tip the balance in favor of fuel oil 4.

D. Variations in external temperature

Two other related questions remain: (a) Are there fixed relationships among the fuels? (b) Do changes in climate have an affect on these relations?

The answer to the first question is "Yes". If we take fuel oil 5a with 8.092 Kcal/Kg supplied and lignite 2 with 1826 Kcal/Kg supplied and express the second as a ratio of the first, we get $1820/8092$ or .229. This figure gives the rate of exchange between the two fuels, i.e., .229 units of fuel oil 5a will supply the same quantity of heat as one unit of lignite 4. In other words, a ratio independent of prices can be constructed by taking the ratios of Kcal/Kg of the commodities.

In answer to the second question there is no reason to think that climate changes the relationships. A Kcal is the same unit of

1/ Verbally from IPRAŞ and Mobil Oil.

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heat regardless of source. There is no known proof that there is any significant change in the efficiency of the source of heat caused by changes in the typical range of climate.

IV- Comparison of fuel oil and coal with respect to costs of usage.^{1/}

A. Nature of the two systems.

Because coal burning systems are convertible to fuel oil burning ones and vice-versa, the basic equipment of the two systems is the same. In this section the conversion of a coal burning system to fuel-oil burning is analysed. Conversion of a fuel-burning system to one utilizing coal is not considered because the latter has high fuel costs and cost of conversion is small. The costs of converting from coal to fuel oil can be classified as incremental costs.

Much of the equipment is common to both systems. It is only the extra items that need be considered.

A further point is that fuel oil 6 has a high pour point of 20 C (see Table I) ^{2/}. At a temperature below 20 degrees centigrade the fuel is in solid or semi-solid form and thus requires special heating equipment before it can be used. ^{3/} However, since the entire output - present and potential - is and will continue to be absorbed by industry, no further discussion of this type of fuel is necessary.

Further discussion of fuel oil 4 also can be dropped. It was pointed out earlier that because of the high "production-tax" the entire supply of this fuel is absorbed by the government and is used in the nationalized transportation system.

-
- ^{1/} The data in this section were supplied by (1) Riello, (2) Körting, and (3) BP, (former two are dealers in the installation of heating systems).
 - ^{2/} Pour point is defined as the lowest temperature at which a liquid will flow when a test container is inverted under standard conditions.
 - ^{3/} Fuel oils 5(a) and 5(b) also require heating equipment. However, the cost of this equipment is much lower than the cost of equipment required for fuel oil 6.

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Elimination of fuel oils 4 and 6 from further discussion leaves only types 5a and 5b for further consideration.

B. Incremental fixed costs of converting from coal to fuel oil.

The following cost figures include labor and other allied expenses for each item:

a. Storage tank <u>1/</u>	3,000 TL.
b. Pipe line to furnace	700
c. Electric wiring	600
d. Electric heating equipment	8,500
e. Firebricks	400
	<hr/>
Total	13,200 TL.
	<hr/>
Arbitrary safety margin (15%)	1,980
	<hr/>
Total fixed costs of conversion	<u>15,180 TL.</u>

C. Variable Costs.

The following variable costs are incurred in the operation of the two systems and are based on a winter season lasting five months:

	<u>Per month</u>	<u>5 months</u>
<u>Fuel oil</u>		
a. Electric power	120 TL .	600 TL .
b. Maintenance	100	500
	<hr/>	<hr/>
Total variable costs	<u>220 TL.</u>	<u>1,100 TL.</u>
<u>Coal</u>		
a. Wages of tender	400 TL.	2,000 TL.
b. Cleaning <u>2/</u>		
c. Transportation <u>2/</u>		
	<hr/>	<hr/>
Total variable costs	<u>400 TL.</u>	<u>2,000 TL.</u>

1/ Three tons is the maximum capacity allowed by the municipality.
2/ Exact amounts depend on negotiation (cleaning) and distance from coal depot (transportation). The total amount should not be greater than ten percent of total variable costs. It is ignored here because of this variability and because of its minor importance. The net effect only makes the fuel oil alternative that much more attractive.

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With costs as given above and use restricted to a five-month winter season, annual savings will amount to 900 ₺. (2,000 ₺. - 1,100 ₺.). In addition to these savings there will be the savings resulting from using the less expensive fuel.

D. Payoff period.

Payoff period of the conversion can be calculated by dividing 15,180 ₺. (the total fixed costs of conversion) by annual total savings, i.e., savings in fuel costs plus the reduction in the other variable costs.

Annual savings will be based on a hypothetical model. However, the data for an apartment house of this model are factual and were supplied by British Petroleum. With the exception of two items not yet mentioned, namely, a safety factor and hourly needs in terms of Kcal/Hour, the figures are the same as those given in the earlier analysis.

The safety factor in the order of 2 is an empirical factor and is used by the industry to adjust for general insulation, etc; while the estimated hourly need, based on average figures, is given at 110,000 Kcal/Hour. It is further estimated that the system is an operation at an average of 18 hours per day for a total of 150 days (5 months x 30 days).

Assuming that the fuel used is 5(a)(the most common type used), the following figures are applicable: calories supplied of 10,600 Kcal/Kg at an efficiency of .75.

Under these assumptions the need for fuel oil 5(a) is 18,679 Kg, computed as follows:

$$\frac{110,000 \times 18 \times 150}{10,600 \times .75 \times 2} = \frac{297,000,000}{15,900} = 18,679 \text{ Kg}$$

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Assuming the use of lignite 3, which gives the highest Kcal/ℓ. of the lignite group, the following figures are applicable: calories supplied of 4,500 Kcal/Kg at an efficiency of .35.

Under these assumptions the need for lignite 3 is 94,286 Kg, computed as follows:

$$\frac{110,000 \times 18 \times 150}{4,500 \times .35 \times 2} = \frac{297,000,000}{3,150} = 94,286 \text{ Kg}$$

Total annual variable costs and annual savings can now be summarized:

	<u>Fuel oil 5a</u>	<u>Lignite 3</u>
Fuel costs:		
18,679 Kg x .39 ℓ. =	7,285 ℓ.	
94,286 Kg x .12 ℓ. =		11,314 ℓ.
Total other variable expenses	1,100	2,000
Total annual variable costs	<u>8,385 ℓ.</u>	<u>13,314 ℓ.</u>
Annual savings		<u>4,929 ℓ.</u>

The payout period under these circumstances is 3.08 years, computed as follows:

$$15,180 \text{ ℓ. conversion costs} / 4,929 \text{ ℓ. annual savings} = 3.08 \text{ years.}$$

Finally, rate of return on incremental investment can be computed from compound interest tables under different assumptions as to estimated life. These are summarized below on a pre-tax level:

<u>Estimated life</u>	<u>Rate of return</u>
5 years	18.69 %
10	30.03
15	31.33
20	32.53

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Even with the high rates of interest existing in Turkey, the profit rate on the conversion investment appears quite adequate.

The assumptions underlying the above analysis are:

(1) Constant prices for the two commodities. This assumption is reasonable in the short run because changes in the price of coal are subject to government control and are likely to have political repercussions. At the same time an increase in fuel oil prices is not very likely because of competitive reasons.

(2) Equal obsolescence rates are assumed for both systems. This assumption is also reasonable because both systems are the same except for the heaters and the electrical needs of the fuel oil system. The electrical wiring will last indefinitely; while the heating unit, guaranteed for three years, can be expected to last as long as the furnace.

E. Intangible elements.

In addition to the cost savings, there are certain intangibles that serve to favor the fuel oil system: (1) Fuel oil requires less storage space; (2) Fuel oil, unlike coal, is not dusty; (3) Fuel oil produces less smog.

Conclusions:

Considering the sizeable cost savings and the intangibles, fuel oil appears to have a decided advantage over coal as a source of heat for apartments and other home units.

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Chapter III

Market Structure

Limits of the chapter:

The material of this chapter is largely restricted to description and analysis of marketing organizations in the fuel oil and coal industries. It contains virtually no statistical data because such data is not available. Companies in each of the two industries hold back such information ostensibly for competitive reasons.

I- Agency structure

Fuel Oil:

A. Production and refining.

The following firms are actively engaged in the production and refining of petroleum in Turkey: Türk Petrolleri Anonim Ortaklığı (T.P.A.O.), Mobil Oil, and Shell. The first of these makes its sales entirely from home production; the other two supplement their production with imports of raw petroleum which is subsequently refined at the ATAŞ refinery in Mersin (see below). A fourth firm, British Petroleum (BP), imports all its raw product and has it processed at the Mersin refinery. A fifth firm, Caltex, restricts its activities to the partly owned IPRAŞ refinery at İzmit. The sales of all products in the Turkish market are made at the same prices as domestic production.

The relatively high cost of importing processed petroleum calls for the construction of refineries. Currently there are three refineries in Turkey: 1/

1/ Neyzi, N., Türkiyede Petrol Sanayii, İktisad Fakültesi, p. 156.

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- (1) The Batman refinery, 100% owned by T.P.A.O.
- (2) The ATAŞ refinery at Mersin jointly owned by Mobil Oil (56%), Shell (27%) and British Petroleum (17%).
- (3) The İPRAŞ refinery at İzmit jointly owned by T.P.A.O. (51%) and Caltex (49%).

The three refineries and the five respective firms exercising ownership produce the entire fuel oil supply on Turkey.

B. Wholesaling.

The wholesaling function is accounted for by four firms:

- (1) Petrol ofisi - a state owned organization. This firm wholesales the entire output of the Batman and İPRAŞ refineries.
- (2) Mobil Oil.
- (3) Shell.
- (4) British Petroleum (BP).

The three foreign firms have varying degrees of autonomy in that Mobil Oil is a subsidiary of the United States firm of the same name; while Shell and British Petroleum are branches of their respective home firms.

C. Retailing

The retailing function of fuel oil is carried on by the affiliates of these organizations as listed below. Some of these retailers are partly owned by the wholesaling agencies while others work on a contractual basis. (see below: II- Inter-agency relationships; (2) Retailer level.)

- (1) Petrol ofisi agencies:
 - a. Ak-Yak
 - b. Türker Petrol
 - c. Isı-Lit (jointly owned with T.P.A.O.)

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(2) Mobil Oil Agencies:

- a. Türk Petrol (not to be confused with the T.P.A.O. organization)
- b. İstanbul Petrol
- c. O Pet (an intermediary between Mobil Oil and several retailers, with only one having any role in the fuel oil market/7-10% of Mobil's sales in İstanbul/, namely Ak-Pet.)

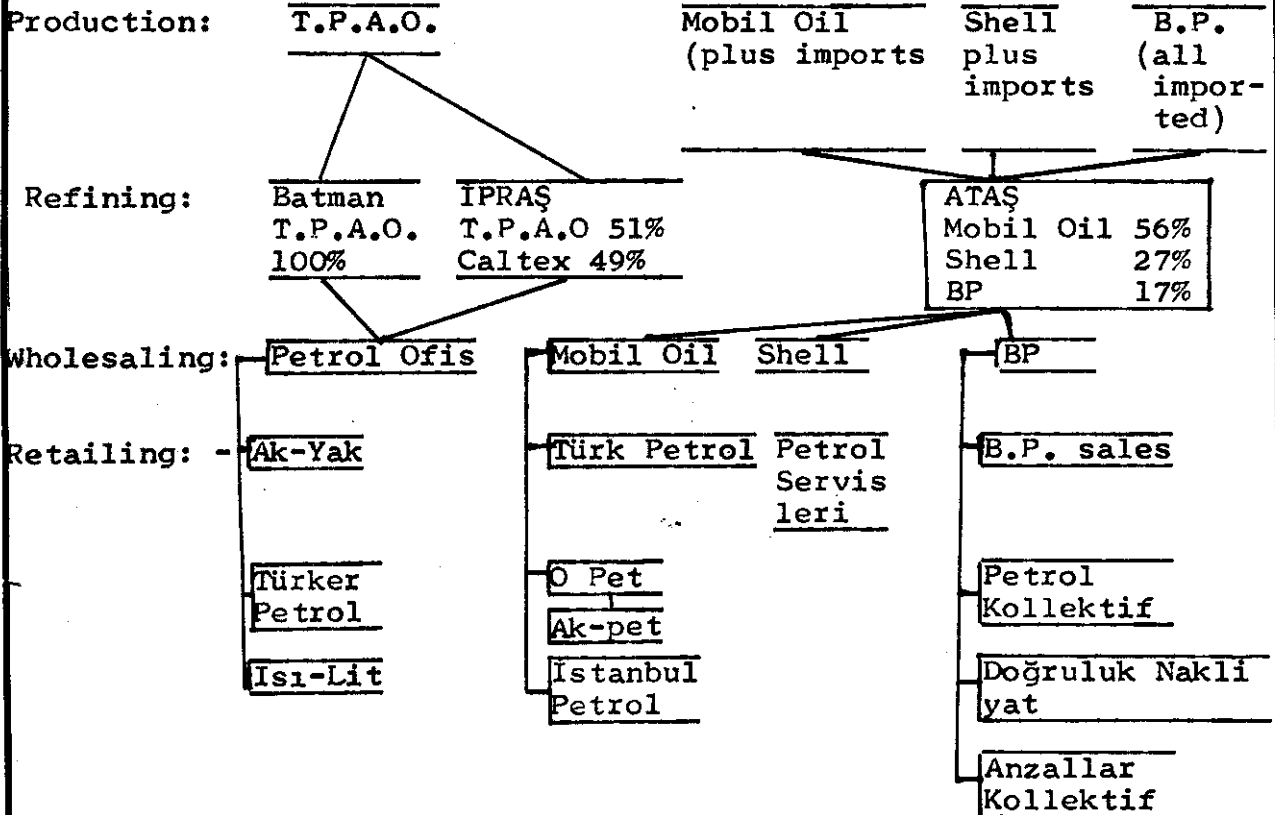
(3) Shell agencies

- a. Petrol Servisleri

(4) British Petroleum. This firm follows a different policy in that it acts as its own retailer as well as having contractual relations with the following small retailers:

- a. Petrol Kollektif
- b. Doğruluk Nakliyat
- c. Anzallar Kollektif

The above data can be summarized in the following chart:



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D. Competition

As indicated in the above data the different segments of the petroleum market show varying degrees of imperfect competition.

On the production level in 1963 T.P.A.O. produced 618,000 tons, Mobil 57,000 tons, Shell 83,000 tons. 1/ However, imports by the latter two firms and British Petroleum amounted to 2 941 300 tons in the same year. 2/

The same competitive structure is carried on to the refining and wholesale levels because the same four producers are the only refiners and wholesalers in the country.

The competitive structure on the retail level is more complex. In the first place, competition is restricted because the source of supply is limited to that of the four firms doing all of the wholesaling. Assuming price leadership exists, material costs are the same for all retailers. Secondly, selling prices are also uniform. Consequently, what competition exists is in the nature of the Chamberlin model, i.e., advertising, service, and location.

The transformation from an oligopolistic situation in the producing, refining, and wholesaling levels to that of monopolistic competition on the retailer level is due to a number of factors. First, the large producer - refiner - wholesaler does not consider retailing to be profitable - net profits amount to but one-half of one per cent of sales. 3/ In addition the extra administrative work is formidable. (B.P. is the only large firm doing any retailing but, as will be seen later, it has other considerations in mind.) Second, each of the smaller firms has insufficient capital for the expansion of its market. Low profits prevent internal

1/ Neyzi, N., op cit., p. 154

2/ Development Plan, 1963 Annual Programme Table 46 p.75
D.P.T. Ankara

3/ This figure was supplied by Istanbul Petrol. Although it cannot be confirmed, it is likely that it is the prevalent one because this firm is one with a large market share.

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growth and attraction of new capital. Third, the relatively small amount of capital needed to enter the market provides a relatively high "ease of entrance" - any individual with enough capital to buy a tanker truck can enter the market. 1/ No individual is refused entrance because of the fear that competing wholesalers will grant the dealership and thereby gain a larger share of the market. The net effect of all this is a market served by many small retailers who are supplied by an oligopoly of four wholesalers. The result is high non-price competition on the retail level.

Coal:

All of the anthracite and 85% of the lignite market is under government control. A large number of small private firms account for the remaining 15% of the lignite market.

A. Government sector.

The right of exploiting anthracite and lignite deposits in this sector is held by Türkiye Kömür İşletmeleri (T.K.İ.). Four affiliated firms (three on the producing end and one on the wholesaling end) form the body of the organization. Each of the producing firms has the mining rights of anthracite or lignite in its district. These are based on geographical factors. The three producers are:

- (1) Ereğli Kömür İşletmeleri (E.K.İ. - Ereğli Anthracite).
This firm holds the rights over all anthracite deposits.
- (2) Garp Linyitleri İşletmesi (G.L.İ. - Western Lignite)
- (3) Şark Linyitleri İşletmesi (Ş.L.İ. - Eastern Lignite)

The wholesale-retail activities are carried on by Kömür Satış ve Tevzii Müessesesi (K.S.T. - Coal Sales and Distribution).

1/ Ak-Yak, Ak-Pet, Petrol Kollektif, Anzallar Kollektif and Doğruluk Nakliyat all got their start this way.

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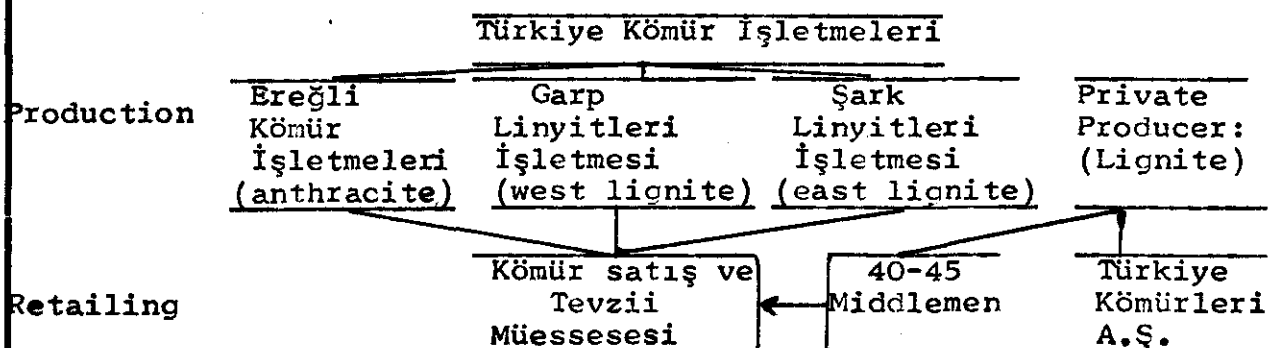
This firm operates through many branch offices located in all parts of Turkey.

B. Private sector.

Production is carried on in the private sector; however, the number of such firms is not known. The distribution activities, on the other hand, are carried on by only one firm - Türkiye Kömürleri A.Ş. (Turkish Coal Company). Currently this company restricts its activities to Ankara. The company failed in an attempt to open an office in Istanbul. (distribution for the private producers in this city is now handled by K.S.T.)

Actually, the distribution takes place after a number of small middlemen perform their function. These firms are small in size and number about 40 to 45. Their composition changes quite frequently; as old firms leave the market, new firms come in. These firms purchase lignite from government and private producers and then sell it to distributors. Their profit is the differential between the price paid by the distributor and the price paid to the producer plus the cost of moving the product. Success, then, is measured in terms of their ability to truck the product at a low cost.

The data of these last two sections can be summarized in the following chart:



Note: Although not indicated in chart, the middlemen also make purchases from government-owned mines.

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C. Competition

Anthracite is a monopoly and lignite is a virtual monopoly. Control of both is in the hands of T.K.İ. This government-owned company sets the price of anthracite independently, and acts the part of price - leader with lignite. Prices are set by balancing social welfare considerations against the economic consideration of government revenue.

II- Inter-agency relationships.

A. Fuel oil market.

(1) Producer-wholesaler level:

At this level two types of relationships exist side by side. On the one side are the domestic government-owned firms subject to the control of political decision makers. On the other side are the foreign firms, owned by private enterprise, whose activities are directed by their head offices in the home countries.

The only example of the first type at the producer level is T.P.A.O. This company has a separate budget received from other government agencies and has its director appointed by the Cabinet, subject to Presidential approval.

At the wholesale level Petrol Ofisi falls in the same category with respect to budget and executive level appointment. It is legally independent of the T.P.A.O. This company's relationship is defined by the Parliament and its contracts are subject to Cabinet approval. It is also subject to the supervision of the Petroleum Division of the Ministry of Energy and Natural Resources.

As for the foreign firms at the producer level, Mobil Oil and Shell are closely tied to large international concerns. Their policies and budgets are under the close control and supervision

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of their head offices.

All the wholesaling activities of the foreign firms are carried on through separate departments within the organizational structure of each firm.

The British firm BP enters the market at the refining level and has its own refining, wholesaling, and retailing organizations.

(2) Retailer level:

At this level the organizations also fall into two types:

a. Independents. These are independent of the wholesaling concerns with respect to ownership; their relations being regulated according to contractual agreement. The firms in this category are:

Wholesaler

Petrol Ofis
Mobil Oil
Shell
B.P.

Retail Outlets

Ak Yak
Türk Petrol, O Pet, Ak Pet
Petrol Servisleri
Petrol Kollektif, Anzalar
Kollekyif, Doğruluk
Nakliyat

Exact data on the nature of the contracts is not available; however it is believed that these cover the following points. 1/

- a. The products sold.
- b. The quantity discounts granted by the wholesaler to the retailer.
- c. The terms of credit granted by the wholesaler to the retailer for the purchase of trucks, equipment, etc. This item is important because in a rapidly expanding market with a high ease of entry, survival and expansion depend on the availability of funds.

1/ Neyzi, N., op cit. P. ?

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b. Affiliates. Here the large wholesaling concerns own a share of the retailing unit. This gives them some form of control over the activities of the latter. The firms in this category are:

<u>Retailer</u>	<u>% Owned by Wholesaler</u>
Türker Petrol	25% by Petrol Ofis
İsı Lit	51% by Petrol Ofis
	49% by T.P.A.O.
İstanbul Petrol	90% by Mobil Oil

For the wholesaler the affiliate type of relationship presents the following advantages:

- a. Because the subsidiary is organized as a separate firm, any losses suffered by it will not show on the books of the parent. Any needed credits to cover losses of the subsidiary, moreover, will appear on the parent's books as increased investment (and, incidentally, increase the parent's control over the subsidiary). In other words, any losses suffered by a subsidiary do not appear on the parent's book; i.e., providing the subsidiary does not go bankrupt. However, opportunity losses will result even if they do not appear on the books.
- b. A separate organization makes it possible for the wholesaler to sell to the retailer at the prevailing market price and thus show a book profit from its sales to the subsidiary; and perhaps gaining from the subsidiary's sales to the final consumer if done on a profitable basis.
- c. The parent can appoint personnel as executives of the subsidiary and thereby control the activities of the latter. These salaries are borne by the subsidiary.

The affiliate form of relationship is the less advantageous of the two for the retailer. 1/

1/ Isı Lit is an exception since it is part of the government complex.

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It usually comes about when an independent, after establishing a market share of its own, tries to play off a competing wholesaling agency against the one with which it currently has contractual terms. When this happens the wholesaler presses for payment the credits granted for the purchase of fixed assets and other items. The inability to meet these obligations forces the independent to issue ownership shares to the wholesaler.

B.P.'s wholesale-retail policy forms the main exception to that presented above. This company maintains its own wholesale-retail organization and has a number of small retailers under contract. As a result it is possible for BP to exercise constant control over the activities of the retailers under contract. Any action on their part which is not wholly in accord with BP policy will result in a cutting off of the supply of the smaller firm. In the meantime BP itself moves in on this section of the market.

The wisdom of BP's over-all policy can be questioned on the basis of the expenses incurred for the maintenance of a full scale retail organization within the firm. However, it is the company's policy to handle the larger orders itself, and leave the smaller ones for the retailers under contract.

Conclusions: The statement made earlier to the effect that the retail market is a monopolistically competitive one needs qualification in light of the above. The retail firms were founded and subsidized by the wholesalers in order to tap the deeper recesses of the market. Though monopolistically competitive in their daily operations they do not have sufficient autonomy for the usual analysis of monopolistic competition to apply fully. This is because any action of the oligopolistic wholesale market is quickly reflected at the retail level. Furthermore, the nature of the contractual relations and the financial weakness of the

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retail organizations makes it difficult, if not impossible, for the latter to take any kind of collusive action against the wholesaling agencies. Also ease of entrance to the retail market further weakens the position of these already in it.

B. Coal Market.

The activities of T.K.İ. and that company's relations with its affiliates are regulated by acts of Parliament (Law No: 6974 and Law No: 3460). These give T.K.İ. monopoly rights over the anthracite market but leave the lignite market open to private enterprise.

The wholesale organization K.S.T. has established various sales points throughout Turkey (13 sales points in Istanbul) and sells to the consumer from these points. Transport costs from the sales point are borne by the consumer.

K.S.T. also acts as distributor for private producers, as in Istanbul, by purchasing the output of the latter at a discount and then selling it to the final consumer at market price.

It is the view of the industry that a widely disseminated knowledge about the nature and properties of coal, plus the monopolistic character of the market in Istanbul, make it unnecessary for the institutions concerned to engage in advertising. 1/

III-Retailer-consumer relationships.

A. Fuel oil market.

In this market where a consumer faces a retailer of small size in terms of market share, the final decision on the price-quantity relationship is determined by the relative bargaining power of each, i.e., if the quantity involved is large and if the deal makes an appreciable difference to the company, the bargaining

1/ Although fuel oil and coal provide the same service, the latter is better established in the Turkish market because of its longer history as a fuel in the country (since the turn of the century). Fuel oil entered the market in 1962 at which time it was virtually unknown.

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position of the consumer is strengthened. The final retail price is also affected by such factors as whether the transaction is cash or credit and, if credit, the size of downpayment.

Due to the competitive nature of the market retailer policies toward the consumer tend to be uniform and can be summarized as follows:

- a. Each retailer in the fall makes a contract with an apartment house owner. This is renewable at the end of the winter season.
- b. Discount policy is uniform and is based on the quantity purchased by the consumer.
- c. Maximum delivery time is 24 hours; hence orders must be placed a day in advance.
- d. On the basis of its tie-in with a wholesaler, each dealer enters into contracts with builders to assist in the installation of fuel-oil systems. This is done for a commission. In addition all retailers bid for installation work on an independent contractor basis.
- e. Advertising is directed toward the consumer in the following ways:

- (1) Institutional advertising to increase the demand for fuel oil.

- (2) Brand and company advertising to increase the demand for the dealers product.

All advertising stresses the advantage of fuel-oil over coal with respect to cleanliness, service, economy, etc. Advertising expenditures are paid for by the retailer. However, the size of the advertising budget depends on the contractual terms between the wholesaler and the retailer.

B. Coal market.

As pointed out earlier, prices are based on a social-welfare, government revenue basis.

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All other matters can best be described as being on a take-it or leave-it basis. Coal and lignite are available at sales points at a fixed price to be picked up by the consumer if he so wishes (in the case of anthracite the government transportation industry is the sole consumer). Promotion is non-existent.

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Chapter IV

Conclusions

Limits of the chapter:

This final chapter analyzes the following topics:

- (1) The growth in the number of apartment houses using fuel oil for central heating since the product was first introduced in the İstanbul market in the summer of 1961.
- (2) The change in the relative positions of fuel oil and coal in the fuel market for central heating in the İstanbul market.
- (3) The future of fuel oil for central heating of apartment houses in İstanbul.
- (4) The general applicability of these findings to the total market picture in Turkey.

I- The use of fuel oil for central heating in İstanbul, 1961-65.

The only two fuels used for central heating in İstanbul currently are fuel oil and coal. Fuel oil entered the Turkish heating market in the summer of 1961. Since that time fuel oil systems have been installed in a number of newly built apartment houses and some of the buildings built prior to that time have converted from coal to fuel oil.

It is estimated that 60% of the apartment houses built each year since 1960 contain central heating. ^{1/} If this is true then the newly built apartment houses with central heating can be estimated to number sixty per cent of the total put up each year.

^{1/} Nezih, N. : Unpublished study.

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Table I makes these estimates.

Table I

Apartment Houses with Central Heating Constructed in Istanbul

	1961 - 1965	
Year	(1) Total number constructed <u>1/</u>	(2) Estimated number with central heating (60% of column 1)
1961	1,500	900
1962	1,920	1,152
1963	1,873	1,124
1964	2,142	1,285
1965	1,519 <u>2/</u>	911
Totals	<u>8,954</u>	<u>5,372</u>

The number of apartment houses in Istanbul utilizing fuel oil for central heating during this period and the annual rate of increase are given in Table II. These figures are based on the estimates provided by Istanbul Petrol and Shell Oil as noted in the footnote to Table I.

Table II

Number of Apartment Houses in Istanbul Using Fuel Oil for Central

Heating

and

Annual Rate of Increase

1961 - 1965

Year	Number of apartment houses	Annual rate of increase
1961	12	-
1962	45	275%
1963	240	433
1964	530	121
1965	780	47

1/ Monthly Bulletin of Statistics, August 1965, State Institute Statistics.

2/ Obtained from Istanbul Petrol and confirmed by Shell Oil. This is but an estimate since no company has exact figures about the number of customers secured by competitors.

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Table III assumes that the only users of fuel oil for central heating in apartment houses in Istanbul are those constructed in the 1961-1965 period.

Table III
Per Cent of Apartment Houses in Istanbul
Using Fuel Oil for Central Heating
1961 - 1965

Year	Number of apartment houses constructed	Estimated number with central heating	Estimated number using fuel oil	Fuel oil users as per cent of apartment houses constructed	Fuel oil users as per cent of those with central heating
1961	1,500	900	12	0.8%	1.3 %
1962	1,920	1,152	33	1.7	2.9
1963	1,873	1,124	195	10.4	17.3
1964	2,142	1,285	290	13.5	22.6
1965	1,519	911	250	16.5	27.4
Totals	<u>8,954</u>	<u>5,372</u>	<u>780</u>	<u>8.7%</u>	<u>14.5%</u>

Table II includes all apartment houses using fuel oil for central heating:

(1) Newly installed systems

- a. Apartment houses constructed during the 1961-1965 period.
- b. Apartment houses constructed prior to 1961.

(2) Conversions from coal

- a. Apartment houses constructed during the 1961-1965 period.
- b. Apartment houses constructed prior to 1961.

If the very conservative assumption is made that all of the apartment house fuel oil installations were made only in the

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apartment houses constructed in the 1961-1965 period, then the percentage of fuel oil installations is 8.7 per cent of all such newly constructed houses and 14.5 per cent of those newly constructed apartment houses with central heating. Stated in other terms, 91.3 per cent of all apartment houses constructed during this period do not have fuel oil systems and 84.5 per cent of all such apartment houses with central heating use coal.

On the other hand, if we assume that some of the apartment houses using fuel oil for central heating are houses constructed prior to 1961 and that some of those constructed during 1961-1965 have converted from coal, then the percentage figures above are that much understated. Mr. N. Neyzi stated in an interview with the writer that he estimated that 90 per cent of the apartment houses in Istanbul having central heating use coal. This last figure is in line with the estimates made above.

The existence of this large unexploited market accounts for the great proliferation of fuel oil retailers in the Istanbul area.

This fact also substantiates the claim made in Chapter III that there is a definite transition from the oligopoly existing on the wholesale level to something that approximates monopolistic competition on the retail level.

II- The relative positions of fuel oil and coal in the current Istanbul central heating market.

It was explained in Chapter II that fuel oil and coal are substitutes for each other. As of now the Istanbul market is heavily dominated by coal. Yet, as we have seen, fuel oil is much the superior product. Why this preference for coal?

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The answer is two-fold:

- (1) Psychologically the Turkish consumer is ultra-conservative. Coal has had a long history in Turkey while fuel oil is an upstart.
- (2) The fuel oil industry has been slow in getting its message across to the general public.

Conclusions: The future of fuel oil vis-a-vis coal for central heating in Turkey.

Coal dominates the fuel market for central heating of apartment houses in Istanbul. This position is transitory. As information spreads the position should be reversed. Tables II and III indicate the trend of future events. Rapidity of change depends mainly on the ability of the fuel oil suppliers to get their message across to the consumer.

Istanbul was selected as the focus of study of the fuel oil market for central heating of apartment houses in Turkey. Yet, the following findings also apply to the Turkish market as a whole:

- (1) Fuel oil is the superior product and costs much less than coal in terms of heat units supplied.
- (2) Conversion from coal to fuel oil can be highly profitable. On the other hand, there is a complication and an economic question when we consider the Turkish market in its totality.

The economic question is taken up first. As the geographic market expands, will retailers remain small and diffuse, or will a few giants emerge should large city retailers enter the national market? In other words will monopolistic competition or oligopoly prevail? Which would benefit the consumer most? The competitive

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elements of many firms or the countervailing power of a retailer oligopoly facing a wholesaler oligopoly?

If the Turkish government takes no positive action in this area, then only future events can provide an answer. All we know now is that the Istanbul market is served by a large number of retailers.

The complication is the problem of transportation and storage.

Presently the state railway has facilities for the transportation of coal. Fuel oil will need similar equipment, either railroad tank cars or trucks. Consequently, two questions remain unanswered: (1) Can the equipment be made available considering Turkey's foreign exchange problems; and (2) What will be the relative costs of transporting fuel oil and coal? The answers lie in the political domain and cannot be answered here.

A similar problem arises with respect to storage facilities. Large storage tanks will be needed in the various market areas. Can they be obtained and will they have an appreciable effect on costs? These cannot be answered for the same reason.

The only statements that can be made with any assurance are that large cities, such as Istanbul and Ankara, already use fuel oil; and as for the rest of the market, growth will depend on size of city and number and concentration of potential customers.

On the other hand, the rate of this growth will depend on many factors: entrepreneurship, availability of capital, availability of equipment and transport facilities, and political considerations.

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3. Petrol Ofis - Marmara Regional Division. İstanbul
4. Shell - Marketing Division. Taksim, İstanbul
5. B.P. - Marketing Division. Taksim, İstanbul

II. Retail Level.

- | | |
|---------------------------|----------|
| 1. İstanbul Petrol | Beyoğlu |
| 2. Ak-Yak | Galata |
| 3. Ak-Pet | Beşiktaş |
| 4. Petrol Servisleri | Harbiye |
| 5. B.P. Retail Department | Harbiye |
| 6. Türker Petrol | Tophane |

III. Fuel Oil Equipment Sellers

- | | |
|------------|---------|
| 1. Riello | Harbiye |
| 2. Körting | Harbiye |

B. On Coal.

1. Ereğli Kömür İşletmeleri, İstanbul-Beyoğlu
2. K.S.T. İstanbul-Beşiktaş

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|--------------------|--------------------|
| 3. T.K.İ. | Ankara-Sıhhiye |
| 4. Turkish Coal Co | Ankara-Kanur Sokak |

General, primarily for Fuel Oil:

1. Nezih, Neyzi - Peva.
2. State Planning Department.
3. Ministry of Energy and Natural Resources.
4. State Statistical Institute.