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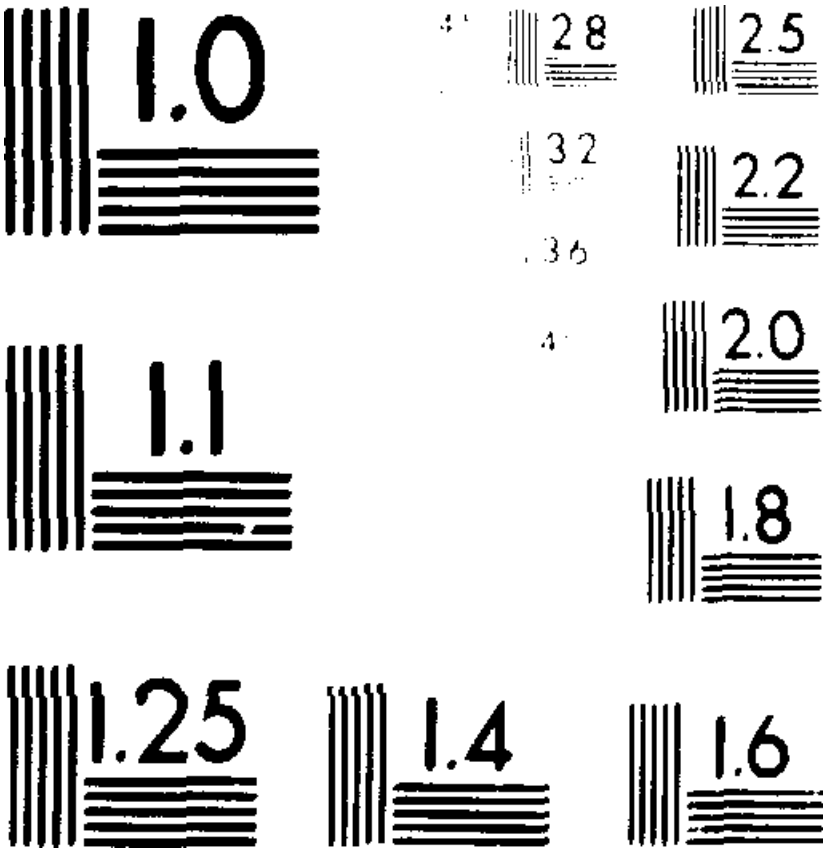

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1981

DEVELOPMENT OF CAPITAL GOODS INDUSTRIES IN TURKEY

DP/TUR/76/034

Turkey.

Technical Report No. 3 - Heavy Duty Diesel Engines with special reference to TÜMOSAN PROJECT

M.M. Luther

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CAPITAL GOODS INDUSTRIES
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UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

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by

M.M.Luther

Chief Technical Adviser

Capital Goods Development Project

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CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

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CHAPTER I

SUMMARY

1.1. Diesel and petrol engines have been identified as one of the priority sectors for Capital Goods Development Project.

1.2. It was felt that out of five types of diesel engines considered in the feasibility report of the Akmosan Project, the manufacture of 250 and 350 HP engines should be deferred and a detailed analysis should be made of demand pattern of the remaining 3 types namely 85 HP, 130 HP and 168 HP.

1.3. Six earlier studies have made varying projections. The models used in the latest, carried out by DESIYAB in 1977, have been used as a basis for this report, after making suitable modifications, to account for changes in techno-economic conditions governing the

demand pattern of diesel engines. Only models based on regression analysis with high correlation coefficient and low variation coefficient have been used.

1.4. The engines under consideration are principally used in buses, trucks and construction machines.(3.2, 3.3, 3.4)

1.5. 85-95% of the demand for trucks is that of 5-9 ton capacity using 130 HP engines. Bus engines are also 130 HP. Majority of construction machines will also use 130 HP engines.

1.6. In addition to three alternative projections of rate of growth, in order to ensure maximum utilization of installed capacities, minimum demand based on pessimistic projections of 3.5% rate of growth of GNP in the period 1981-1990 has been worked out and already planned facilities considered in the context of these estimates.

1.7. Replacement demand makes up nearly 60% of the demand and 6.5% of the total population of trucks and buses based on a 15 year life has been considered as justified as replacement demand.

1.8. No corrections have been made for the possibility of large scale use of Railways as an alternative for trucks.

1.9. Out of 3 engine producers in Turkey, two produce gasoline engines for cars while the third one(BMC) has an installed capacity of 20.000 diesel engines/year of which 10.000 are for truck engines. Although the maximum production of 120 HP engines by BMC in recent years was 4882(in 1976) having gone down to 2193 in 1980, it has been assumed that by 1983 they will achieve a production of 10.000 units. BMC should however be urgently provided with the necessary inputs to achieve its rated capacity.

1.10. 10% of capacity for 130 HP engines should be earmarked for exports for which suitable measures should be taken early. This should include a compact but live marketing organisation.

1.11. In the interest of economic viability, AKMOSAN should concentrate, for the time being on production of only 130 HP engines taking up 85 HP and 168 HP engines after productivity has reached internationally competitive levels and after market investigation in 1984-85. While the plant layouts may be based on 24.000 units per year with two shifts working, the actual purchase of machinery and plant should be subjected to close scrutiny to ensure that it is phased to suit actual requirements.

1.12. Supply of castings and forgings will need to be closely monitored.

1.13. High priority should be given to training of production, industrial, quality control and design engineers in the offices and works of the licenser.

1.14. A continuous watch in decrease of imported content is recommended.

1.15. Special administrative steps may be taken to promote specialised ancillary industries to feed AKMOSAN.

1.16. An upto date multi-level monitoring system covering all aspects of project control, is recommended for immediate installation.

1.17. This report has been discussed with the management of TÜMOSAN who are in agreement with the conclusions and recommendations.

(M.M.Luther)

Chief Technical Adviser

CHAPTER II

INTRODUCTION

2.1. In the Capital Goods Development Project in Turkey for development of capital goods sector, diesel and petrol engines have been identified as one of the priority sectors. This report deals with demand and supply of truck and bus diesel engines, and examines, in particular, the project undertaken by AKMOSAN for production of Truck and Heavy Truck Diesel Engines(SPO's Project No. 780230 010), located at Aksaray/Niğde. The feasibility report for the project(Rev. March 1981) envisages its capacity as 29.000 unit per year, made up as under:

Daimler Benz	OM 314 Model	85 HP engines	6900 units/year
Daimler Benz	OM 352 Model	130 HP engines	10700 units/year
Daimler Benz	OM 352A Model	168 HP engines	6400 units/year
Volvo	TD 100 Model	250 HP engines	3650 units/year
Volvo	TD 120 Model	350 HP engines	1350 units/year
		TOTAL	29000 units/year

2.2. Mr. Ali Ünal of TÜMOSAN was depured by the General Manager of TÜMOSAN to assist in projections of demand and supply and he had a series of meetings with Mr. M.M.Luther, Chief Technical Adviser, UNIDO, for this purpose. The conclusions and recommendations have been discussed with Mr. Orhan Şahinoğlu, the General Manager of TÜMOSAN.

2.3. A note on description and development of the user sector included in the feasibility report of the project is at Ann. I.

2.4. Import of designs, manufacturing technology and tools, etc. is costly and it is important to make their optimum use taking into account the twin factors of the time lag for reaching full efficiency as determined by learning curves for different processes and level of demand as related to economies of scale. In the first instance it was felt that for the present, the manufacture of 250 HP and 350 HP engines should be deferred while a detailed analysis should be made of the demand pattern of all the other types (85 HP, 130 HP and 168 HP) proposed to be covered by one license.

CHAPTER III

DEMAND PROJECTIONS

3.1. Six previous forecasts are available for domestic demand for diesel engines intended for trucks and buses. These forecasts include those made by Türkiye Sınai Tesisler A.Ş. (TÜSTAŞ), Devlet Planlama Teşkilatı(SPO), Boğaziçi University, Türkiye Sınai Kalkınma Bankası(TSKB), Motorlu Araçlar Ticaret A.Ş (MAT) and Devlet Sanayi ve İşçi Yatırım Bankası(DESIYAB). The latest of these forecasts is the one carried out by DESIYAB for the appraisal of TÜMOSAN Truck and Heavy Truck Diesel Engine Project. Even this study, carried out in 1977, is based on statistical figures available up to 1974 and hence, requires revision on the basis of more recent values. Furthermore, the economic conditions in the World and in Turkey have significantly changed since 1977, and thus arises the need to incorporate into demand studies the current economic environment and anticipated pattern of development.

In the present study, DESIYAB approach and projections have been taken as the basis for revision because in the sales forecast and demand for TÜMOSAN engines this study was used. Furthermore, this study gives the lowest demand figures (see Annex 2) which is in line with the present economic expectations. Additionally, this study has predicted demand from GNP correlations and is thus easier to revise.

3.2. AKMOSAN's project under consideration, plans to produce 3 types of medium power automotive engines between 85-168 HP. Accordingly, in demand studies automotive sector carries the biggest weight.

3.3. As the domestic demand for diesel automotive engines will be directly related to the production of buses and trucks in Turkey, the production figures of trucks and buses can be considered equal to demand for the engines covered by the project.

3.4. Forecast of demand for engines is made by forecasting the demand for trucks, buses and construction machines (hereinafter called vehicles) in which engines will be installed. Being intermediate goods from economic

standpoint, the demand for engines is derivative. Vehicles will be produced according to demand, and demand for engines will depend on their production. Thus both vehicle demand and production have limiting influences on engine demand, which is limited by production capacity shown in Annex 4, in case production capacity exceeds potential demand. The demand for the engines covered by the project has been forecast within this framework.

3.5. DESIYAB FORECASTS

3.5.1. DEMAND FOR TRUCKS

3.5.1.1. DESIYAB forecast the demand for vehicles in Turkey for appraising the first version of the project. Related with truck diesel engines, three different models were tried. In the first model logarithmic and linear time series analyses were applied on diesel truck population for a 19-year period. However, in this report, this model has not been taken as basis for projection on account of its being a trend analysis, and due to relatively high variation coefficients found for the equations.

3.5.1.2. Regression analysis has been used for second and third models. In the second model, relationship between Turkey's truck load traffic(Y_t) and GNP has been studied, making use of truck load traffic and average annual truck load capacity (K) in Turkey. 3-year moving averages of said variables have been taken into calculations. The equation found is given below:

$$Y_t = -11\ 045 + 0,21425\ GNP \qquad r = 0.9926$$

$$V = 8.27\%$$

Truck load traffic was estimated by this equation, assuming 7% growth rate in GNP. Then, by taking average annual load capacity for 1974 as 136.000 tons, average of last six years preceding 1974, and adding 1000 tons for each year after 1974, truck population (including light trucks) was estimated according to the following equation:

$$P = \frac{1}{K} (-11045 + 0.21425\ GNP)$$

Increases in population indicate annual population demand.

3.5.1.3. For replacement demand, 6.5% of the population has been assumed, taking truck life as 15 years.

3.5.1.4. This model covers both trucks and light trucks(pickups). For this reason, the ratio of diesel truck fleet to total population was found for the last 7 years preceding 1974 (average: 44 %) and diesel truck population reached, assuming this ratio to be constant. Results are given in Annex 6. Accordingly, estimated truck, and consequently, diesel engine demand in 1985 was 26.517 units.

3.5.1.5. This method of deriving diesel truck demand from total population figures assuming that the diesel truck ratio will stay constant is not in line with the present trend in the automotive sector for going over to diesel vehicles. Hence, although the demand figures obtained

by this method(hereafter referred to as DESIYAB 1) are comparable to those obtained by a more realistic approach, as will be seen below (hereafter refeered to as DESIYAB 2), the basis of this method is open to criticism.

3.5.1.6. The third method(DESIYAB 2) also uses a regression model, but this time looking for a direct relationship between GNP and diesel truck population. The equation found is given below:

$$T = -25903 + 0.6183\ GNP$$
$$(2567) \quad (0.0273)$$

$r = 0.988$ $v = 8.28\%$

3.5.1.7. The replacement demand has again been taken as 6.5% of the population and the demand forecasts made according to this equation are given in Annex 7.

3.5.1.8. It will be seen from a comparison of Annexures 6 and 7 that these two regression analysis support each other as far as their conclusions are concerned. For example for the year 1985, DESIYAB 1 model predicts a total demand of 26517 units which is only 2.4% smaller than the 27153 figure predicted by DESIYAB 2.

3.5.1.9. The basis of DESIYAB 2 method is sound and the high correlation coefficient and the low variation coefficient found for the statistical evaluation indicate that th method can be used to predict reliable demand figures. Two objections however, can be realised against this method. One is that the method considers diesel engines as a demand entity, which is not quite true, because the demand entity should be truck engine. Whether the engine selected is a diesel type or a petrol type is a matter of preference. Hence it would be more appropriate to take truck engine as the demand entity and

then diesel engine demand could have been derived from this. The second objection would be against the rather high, 7% rate of growth foreseen in GNP which was probably realistic in 1977 when the study was made, but can no longer be considered attainable for the next five years.

3.5.1.10. For distributing the engine demand into HP ranges, the following assumptions were made in DESIYAB studies:

(i) All trucks in the population have more than 81 HP.

(ii) 85 HP trucks have 4 tons capacity.
130 HP trucks have 5-9 tons capacity.
168 HP trucks have 10-11 tons capacity.

3.5.1.11. As can be seen from Annex 8

(i) 4-ton diesel trucks have a very small share in the population, which share has been assumed to stay at 1.5% in the coming years.

(ii) 5 to 9-ton trucks have occupied 94% of the population between 1966-1972, though a drop has been observed since 1969 - accordingly, 0.5% drop per year was assumed(1974- 94%).

(iii) The remaining portion of the market is shared by 10-11 ton trucks.

3.5.1.12. Annex 9 shows the distribution of demand for truck diesel engines on the basis of above-mentioned ratios.

3.5.2. DEMAND FOR BUSES

3.5.2.1. DESIYAB has tried two methods for the projection of bus demand. First one is the study of the relationship between passenger transport (million passengers/km (Y_t) and GNP, and estimation of bus population(P) according to passenger per bus(k).

$$Y_t = a+b \quad GNP$$

$$K = \frac{Y_t}{P}$$

$$P = \frac{a+b \quad GNP}{K}$$

3.5.2.2. Statistics used for the above relationship are given in Annex 10. After calculations, the relation between Y_t and GNP has been found as follows:

$Y_t = 234508 + 0.513$ GNP $r = 0.987$ $v = 9.4\%$

Then the ratio of 1000 passengers per bus has been found for the 18 years preceding 1974 as 1122 on average and fleet figures estimated by assuming that passenger carrying capacity will increase by 1000 every year until the year 1985.

In calculating replacement demand, bus life has been taken as 15 years.

3.5.2.3. Since the total population found includes all buses and minibuses, diesel bus population has been assumed to form 30% of it in the coming years, and thus diesel bus demand reached. It is felt that it is not correct to assume that this ratio will stay constant at 30% because there is a world wide tendency to go over to diesel engines. Moreover, all diesel buses have been assumed to be above 81 HP. Demand figures are given in Annex 10, according to which 5892 units will be required in 1985.

3.5.2.4. Second trial studies direct relationship between diesel bus population and GNP. The equation found follows:

$$T = 6373.5 + 0.13355\ GNP$$
$$(1289.2)\quad (0.00279)$$

$r = 0.9967$ $v = 4.9\%$

Relative to first one, this trial has yielded lower variation and higher correlation coefficients, standard errors of which are also low. Accordingly, second trial has been taken as basis for projections.

Replacement demand has been assumed as 6.5% as in the previous estimate. Comparison of results is given in Annex 12, in which diesel engine demand in 1985 amounts to 5814 units. To these values, export projections foreseen in SPO-SCR have been added, and total demand figures compared with the production targets stated in the same report, thus concluding that the smaller figures will constitute the effective demand. Annex 12 gives demand figures obtained by this method.

3.5.2.5. Diesel bus engines are taken as 130 HP.

3.5.3. DEMAND FOR CONSTRUCTION MACHINERY

3.5.3.1. As for construction machinery applications, DESIYAB projections are based on the two projects of MKEK. In MKEK construction machinery plant being built in Polatlı, at full capacity, 225 units of loaders (125-140 HP) and other products were then being planned. These latter are to use 180 HP engines.

3.5.3.2. Another venture of MKEK is the large power construction machinery plant to be built in Konya. At full capacity, 158 units of crawler, wheel and ripper bulldozers and motor scrapers were being planned, and of these 613B

type motor scrapers would have 150 HP engine(annually 144 units planned). The second unit of large-power construction machinery project was intended for 1901 units of graders and excavators per year and 1094 of these would be in the 85-168 HP power range.

3.5.3.3. Production figures and HP s of the products planned by MKEK are given below:

Product	HP range	Capacity(units/year)
Loaders (POLATLI)	125-140	225
Bulldozers (KONYA I)	150	144
Grader(12G) (KONYA II)	135	807
Excavator(705R) (KONYA II)	90	201
Wheel excavator (KONYA II)	125	86
	Total	1463 units/year

3.5.3.4. DESIYAB forecasts take this figure of 1463 units/year as the demand for construction machinery applications. However, the production plans of MKEK has changed since 1977 with considerable decrease in production capacities and this has been taken into account in this study.

CHAPTER IV

EVALUATION AND REVISION OF DEMAND PROJECTIONS

4.1. TRUCKS

4.1.1. Truck demand in DESIYAB study is based on a linear relation between GNP and diesel truck population as explained above. With the strong tendency worldwide and countrywide towards diesel engines because of the marked fuel economy afforded, it would be more appropriate to assume that all demand for trucks will be met by diesel run trucks and it is necessary to revise DESIYAB projection to incorporate this.

4.1.2. Economic conditions indicate that 7% rate of growth in GNP as assumed in DESIYAB forecasts is no longer realistic for the immediate future. Thus, in the present study, 3.5% rate of growth was taken until the year 1985 and from 1986 to 1990, it was raised to 5% . Two other alternatives have also been considered namely

(i) 0.5% increase in the rate of growth from 3% in 1981 to 5.5 % in

1986 and thereafter 5.5% upto 1990 (Alt.II and

(ii) a 0.5 % increase each year, in rate of growth from 3% in 1981 to 5% in 1985 and then 6% from 1986 to 1990(Alt.III).

4.1.3 Three regression analyses were carried out between the truck population and GNP figures available for 1966-1979 period. (Annex 13).

The linear regression gave:

$$T = 0.8937\ GNP - 43870 \qquad r = 0.97326 \qquad v = 9.3\%$$

4.1.4. This regression gave a reasonably good correlation coefficient and the variation coefficient of 9.3% indicates that the relation is acceptable. Truck demand forecasts based on this equation are shown in Annex 14.

4.1.5. In the second analysis a semilogarithmic relation was sought between the truck population and GNP. The equation obtained is:

$$\ln T = 9.93884 + 9.3589 \times 10^{-6}\ GNP \qquad r = 0.98832$$

Although this equation gives an even higher correlation coefficient, it has not been used for forecasting because it predicts obviously unrealistic, very high values for years from 1984 onwards (Ann.15). This method cannot take into account impact of a variety of socioeconomic factors which will in actual fact influence the pattern of demand.

4.1.6. The third regression analysis considers a power curve relation between truck population and GNP. The relation obtained is:

$$T = 4.14671 \times 10^{-3} \quad GNP^{1.415823}$$

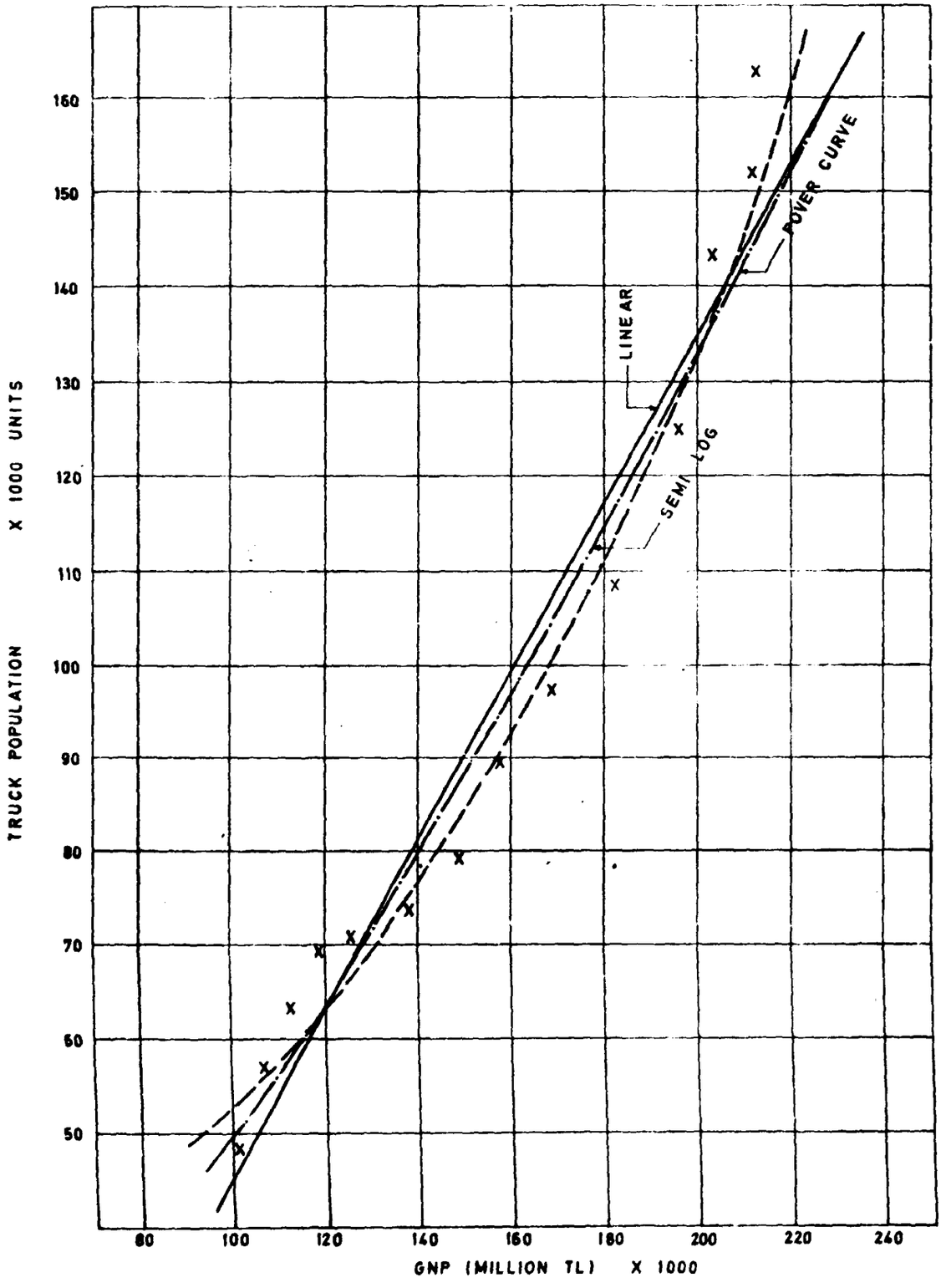
r = 0.98157

v = 8.44%

This equation also has a good correlation coefficient and a low variation coefficient. In these two respects, this equation is slightly better than the linear regression equation. The three analyses are graphically shown in Figure I. (Page 24).

4.1.7. Only linear and power curve regression analyses are worthy of consideration for forecasting demand and both seem to be equally good the only difference being that the predictions of power curve analysis are slightly higher than those of the

FIGURE 1: REGRESSION ANALYSES BETWEEN TRUCK POPULATION AND GNP



linear regression line(see annexes 14 and 16). Accordingly, the averages of these two predictions was taken as the domestic demand for trucks (Alt. I).

As will be seen from Annex 5, truck production capacities are expected to exceed the demand-hence latter can be considered as actual demand. Demand was distributed into HP groups by the method used in DESIYAB studies. The figure shown in Annex 17 represent the demand for diesel engines to be used on trucks.

4.2. BUS DEMAND

4.2.1. Similar regression studies were undertaken for bus demand. The linear regression equation obtained is:

$T = 0.1372 \ GNP - 1488.1$

$r = 0.9934$ $v = 3.35\%$

Because this relation has a very high correlation coefficient and a very low variation coefficient, it was not necessary to try other types of regression and the predictions of this equation was taken as bus demand together with a replacement demand of

6.5% as in the DESIYAB forecasts. The capacities of installed and planned bus production facilities (Annex 5) are sufficient to meet this demand. Demand figures are given in Annex 18.

4.3. CONSTRUCTION MACHINERY DEMAND

4.3.1. As desired by SPO, the Capital Goods Project will study the plans of MKEK. For the purpose of this study, however, the latest production plans of MKEK plants have been taken to represent the demand in late 1980's for this type of application. Revised production capacities for construction machinery of 65-168 HP power range are shown below:

Product	HP range	Capacity(unit/year)
Dozer	168	80
Crawler loader	125	200
Crawler loader	168	40
Exeavator	85	100
Excavator	168	50
	Total	470

4.3.2. Actual yearly production plans of MKEK projects are not yet finalised. It has been assumed, for the purpose of this study, that MKEK plants will start production in 1985 and production figure will be taken 200 for the first year, 300 for the second year and 470 from the third year onwards.

4.4. TOTAL ANTICIPATED DEMAND

4.4.1. Total demand for diesel engines of 85-168 HP power range as predicted in this present study are compared with the DESIYAB results in Table I and the results are also graphically shown in figure 2 (Page 28). It will be seen that the present predictions are lower than those of DESIYAB to percentages varying between 20 and 31.3.

4.5. MINIMUM DEMAND

With the background of the great stress being placed on full utilisation of installed capacities, taking into account the most pessimistic projections, the minimum

FIGURE 2 : DEMAND FORECASTS FOR DIESEL ENGINES

85 - 168 HP POWER RANGE

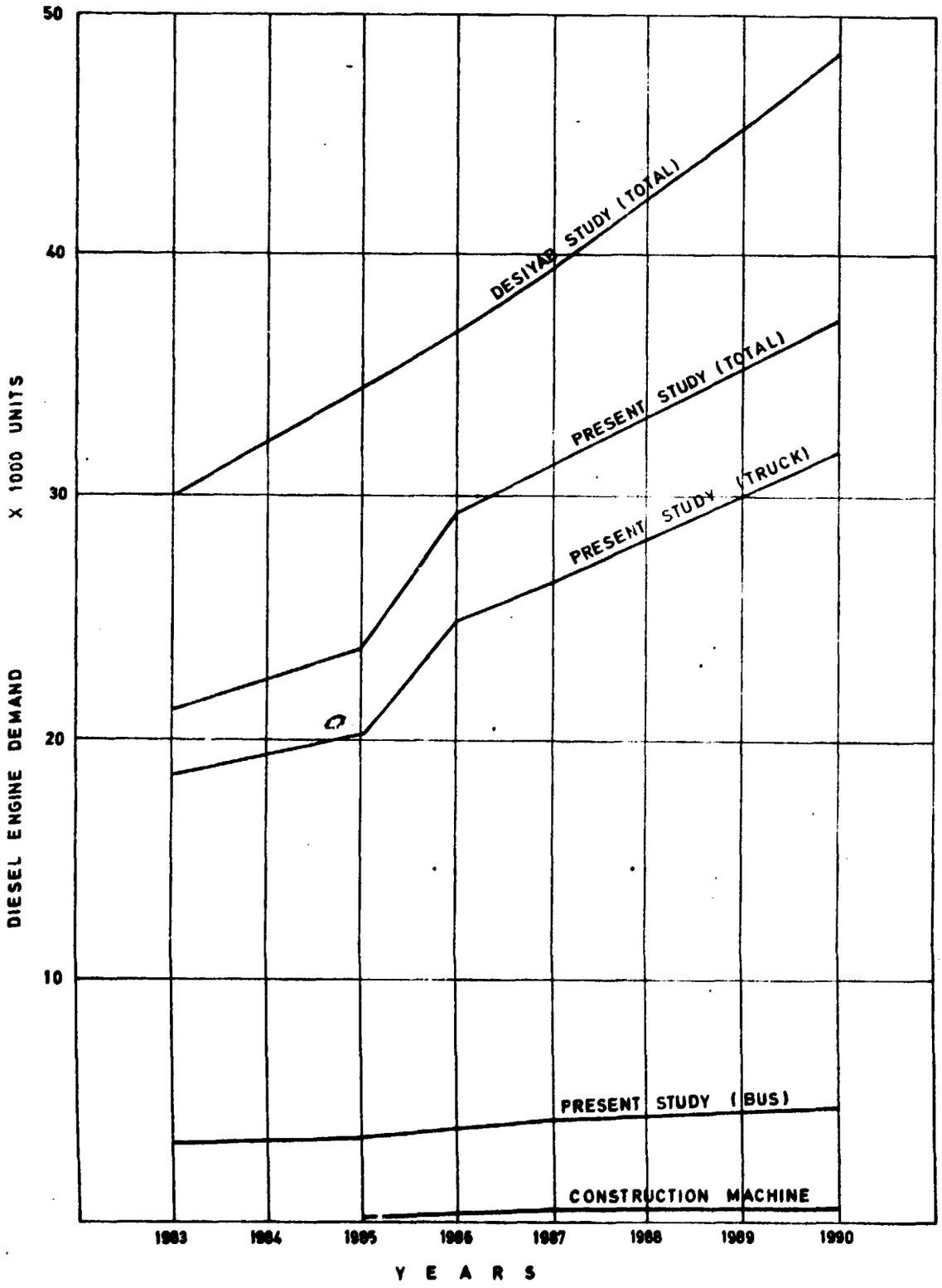
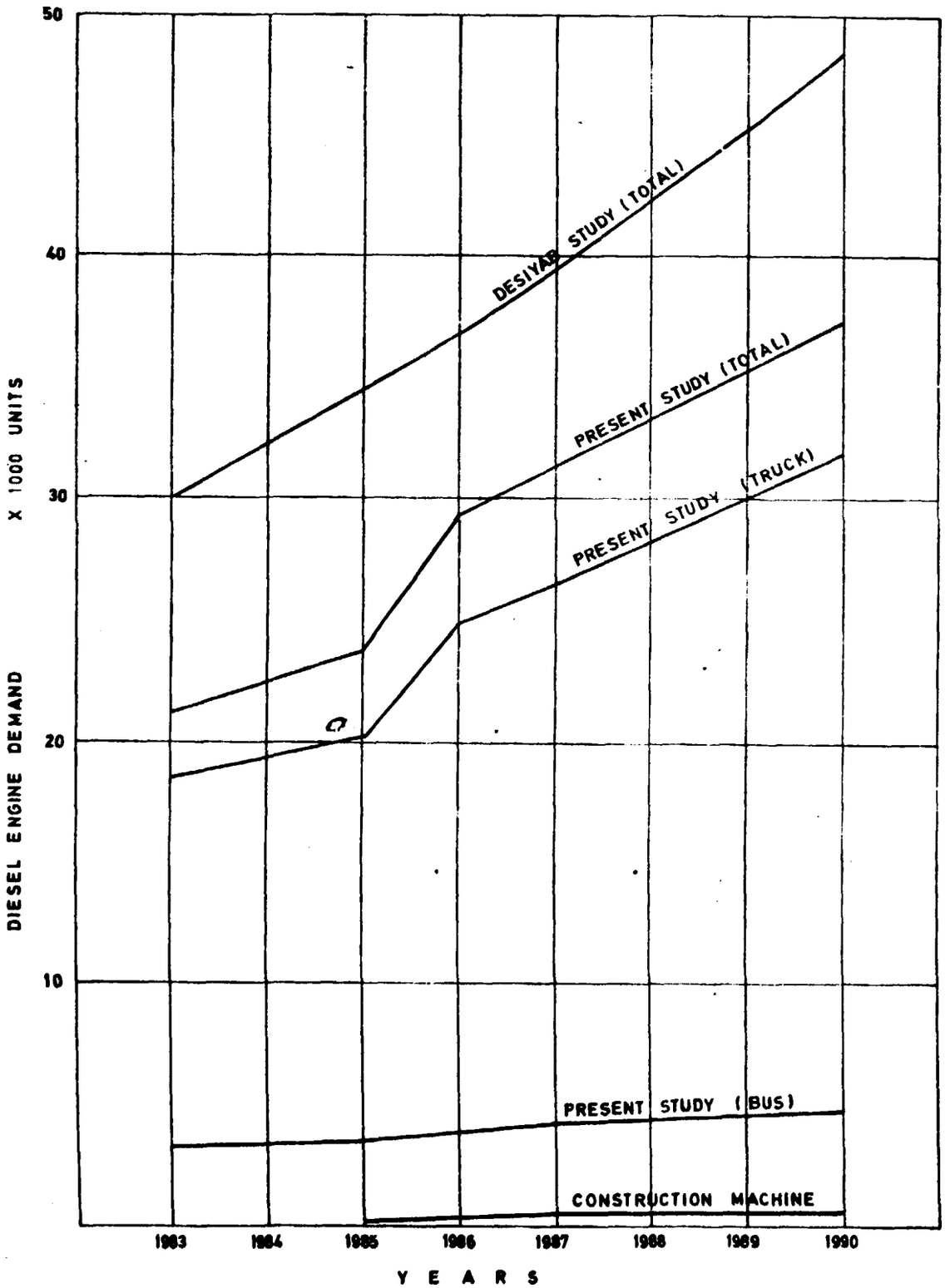


FIGURE 2 : DEMAND FORECASTS FOR DIESEL ENGINES

85 - 168 HP POWER RANGE



UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

TABLE 1 : DOMESTIC DIESEL ENGINE DEMAND FOR TRUCKS , BUSES AND CONSTRUCTION MACHINERY

YEARS	PRESENT STUDY (ALT. I)							TOTAL	DESIYAB STUDY 85-168 HP Range			TOTAL	Percentage difference in total demand foreseen in 2 studies
	85 HP Engine		130 HP Engine			168 HP Engine							
	truck	const mach.	truck	bus	const. mach.	truck	const. mach.		truck	bus	const. mach.		
1983	276	-	16288	3099		1840		21503	23503	5026	1463	29992	- 28.3
1984	289	-	16931	3207		2020		22447	25266	5407	1463	32136	- 30.2
1985	302	43	17595	3329	85	2212	72	23638	27153	5814	1463	34430	- 31.3
1986	374	64	21702	4000	128	2869	108	29245	29171	6250	1463	36884	- 20.8
1987	398	100	22961	4204	200	3186	170	31219	31331	6717	1463	39511	- 21.0
1988	424	100	24288	4420	200	3530	170	33132	33641	7217	1463	42321	- 21.7
1989	451	100	25692	4645	200	3906	170	35164	36114	7750	1463	45327	- 22.4
1990	480	100	27173	4882	200	4315	170	37320	38760	8322	1463	48515	- 23.1

NOTES : 1- Export potential of 130 HP engines not considered.
2- DESIYAB study is based on full production of construction machinery from 1983 onwards.
3- Present study is based on full production of construction machinery from 1987 onwards. Total pf construction machinery to be produced in 1985 and 1986 were taken 200 and 300 units, respectively.

possible demand of diesel engines for truck, bus and construction machinery applications was calculated. For this case, the rate of growth in GNP was taken constant at 3.5% throughout 1981-1990 period(Alt. II). The figures obtained this way, Table 2 (Page 31) are considered as the minimum demand and it will be seen that even the minimum demand in 1990 is 29523 units, 20 % less than 37320 units normally expected.

4.7. IMPACT OF OTHER IMPORTANT FACTORS ON DEMAND

4.7.1. It is now appropriate to consider the influence of three separate factors on these demand forecasts. These three factors are:

a) variations in the useful life of an engine,

b) influence of the economic measures presently applied in the country,

c) railway haulage as an alternative to road haulage.

TABLE 2 : MINIMUM DOMESTIC DEMAND (ALT. 11)

YEARS	DEMAND(UNITS/YEAR) FOR ENGINES OF							TOTAL
	85 HP		130 HP			168 HP		
	Truck	Const. Mach.	Truck	Bus	Const. Mach.	Truck	Const. Mach.	
1983	276	-	16288	3099	-	1840	-	21504
1984	289	-	16931	3207	-	2020	-	22447
1985	302	43	17595	3329	85	2212	72	23638
1986	315	64	18287	3446	128	2417	108	24765
1987	330	100	19001	3570	200	2636	170	26007
1988	344	100	19742	3699	200	2870	170	27125
1989	360	100	20510	3831	200	3119	170	28290
1990	376	100	21308	3967	200	3384	170	29523

4.7.2. ENGINE LIFE

4.7.2.1. It is clear that variations in the useful life of an engine will only influence the replacement demand but not the new demand. Replacement demand makes up between 53-60% of the total demand (for trucks) and hence significant variations in useful life of engines could have an important effect on the total demand figures. It would be possible to assess this effect by varying the useful life within a range. But in fact, the 15-year useful life taken in the projections seems to be sufficiently conservative not to justify this. The age grouping of the truck populations in 1966 and 1970 were as follows:

	0	1	2	3	4	5	6	7	8	9	10	10
1966	6.1.	3.5	3.2	9.0	12.4	7.5	10.6	9.7	2.0	1.4	1.5	33.1
1970	5.0	11.6	10.1	8.8	6.7	2.7	2.4	6.5	8.9	5.2	7.4	24.7

Percentage population in age group

	0	1	2	3	4	5	6	7	8	9	10	≥10
1977	12.8	12.3	11.2	8.3	9.0	6.4	3.5	4.3	7.6	6.1	4.7	13.8
1982	16.9	14.6	12.3	11.5	9.4	7.7	7.2	6.6	4.7	4.5	3.0	1.6

Although the average useful life of a vehicle can not be deduced without elaborate analysis from these figures, it is clear that if the trend predicted by TSK is correct the average useful life must be well below 15 years since the total of vehicles above 10 years of age is going to be only 1.6% of the total in the year 1982. If the useful life were 15 years those below the age of 4 in the year 1966 would be seen in the greater than 10 year age group in 1982, and this would make

(6.1+3.5+3.2+9.0+12.4) % x 47 931 = 16.392 units

As the study by TSKB foresees a total truck population of 195.900 in 1982, this would make:

16 392/ 195 900 = 8.37%

Thus it is apparent that the 15 year of useful life is a conservative estimate. Furthermore it would be difficult to justify from a technical point of view consideration of any longer useful life. In view of this the replacement demand projections as 6.5% of total population is considered realistic.

4.7.3. ECONOMIC MEASURES

It is more difficult to consider the influence of the economic measures presently applied in the country. But part of the influence of this factor should be absorbed in the low rate of growth in GNP which was taken for projections, and it is considered that the pessimistic forecasts based on 3.5% growth rate in GNP should more than account for the influence of anti-inflationary economic measures.

4.7.4. RAILWAY HAULAGE AND FREIGHT

Although railway haulage is always a good alternative for the transport of goods by trucks, except for goods of industrial use such as coal, ores, etc. railway haulage in Turkey has so far not been able to take the place of

lorries for the transport of agricultural products to consumers. Because truck transport is quicker and easier to organise, it is expected that this will continue in the period under consideration(1983-1990) It was therefore decided not to make any corrections for this factor.

CHAPTER V

PRODUCTION CAPACITY

5.1. There are 3 engine producers in Turkey's automotive industry. Of these, OYAK-Renault and TOFAŞ firms produce gasoline engines for automobiles and BMC firm produces diesel engines for trucks, tractors (garden type) and stationary applications. Annual production of gasoline engine producers totals 65.000 units, with 65-80% local content. Production capacity of BMC, the only diesel engine producer in the automotive sector is 20.000 units/year, of which 10.000 units/year are for truck engines.

BMC produces 3 types of 4 and 6 cylinder engines between 52-145 HP range. Local content ratio of the firm, which has achieved a certain level of integration with its foundry and engine block, cylinder head, flywheel, bearing cap and timing gerbox case machining lines, is around 80%.

5.2. CAPACITY FOR MANUFACTURE OF DIESEL ENGINES

Truck and bus production figures for the five year period between 1974 and 1978 are given in Annexes 3 and 4. When the years 1976 and 1977 are taken as basis, as they reflect the production level of the sector more realistically, it will be seen that the diesel engine demand as of these two years is around 22.000 units, of which 5.000 units(23%) has been provided by BMC and 17.000 units(77%) by imports.

5.3. The actual truck production of BMC of 120 HP engines in the last 6 years has been as under:

1975	3831
1976	4882
1977	4520
1978	2810
1979	3066
1980	2193

5.4. BMC have production facilities to go up to a production of 10.000 and it is assumed for the purpose of this study that they will be able to raise their production to this figure by 1983. However full attention will need to be paid to bring this about.

5.5. Supply of castings for engine blocks will be considered in a separate report on Foundry Forge Project of TÜMOSAN.

CHAPTER VI

EXPORTS

6.1. There is a considerable potential for exports of diesel engines and vehicles equipped with diesel engines in the Islamic Group of Countries, particularly the Middle East.

6.2. With the background of conclusions reached that for the time being AKMOSAN should concentrate only on 130 HP diesel engines this report has examined the potential for export of only this engine.

6.3. It is noted that in the SPO-Special Commission Report(SCR) no exports were foreseen for truck or truck engines while some export projections for buses were made. Bus engines are also 130 HP and it is felt that 10% of the production of 130 HP engines should be earmarked for exports either as engines to developing countries(eg.Iran) which have bus building or truck assembly facilities but have not

yet developed matching facilities for engine manufacture , or indirectly in buses and trucks to be exported.

6.4. LICENSING ARRANGEMENT

AKMOSAN is to manufacture these engines under the license of Daimler-Benz AG of West Germany. The license agreements gives the right to AKMOSAN to export the engines and spare parts directly to Libya, Pakistan and Jordan and foresees further extension of this right to other Islamic countries on the basis of experience. Export to other countries is to be decided jointly and shall be channelled through DB's sales and service organisations. Because Mercedes-Benz engines have a good reputation worldwide, AKMOSAN will have the advantage of going to export markets with well-proven products in addition to the optimal geographical situation of Turkey to the Middle-East Markets. Thus, the engines will have an excellent opportunity with respect to export.

6.5. EXPORT PROJECTIONS AND AKMOSAN'S ROLE

The 130 HP (OM-352 type) engine is considered to have the best opportunities in export markets as this engine is installed into trucks of 10-11 ton capacity and into inter-city buses both of which are in common use in

Middle-East countries. A detailed analysis of Middle-East markets has not been undertaken but it is felt that AKMOSAN should undertake the responsibility of realising this level of exports either directly as engines or indirectly as buses and trucks. AKMOSAN should aim to make the best use of this potential both for getting into foreign markets and for the foreign currency to be earned from export which will partly offset the cost of parts AKMOSAN will have to procure from the licensor for its own manufacture.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

7.1. Besides the 250 HP and 30 HP engines, AKMOSAN at present plans to produce 3 engines for tsuck and bus application, 85 HP, 130 HP and 168 HP using specially tooled up machines and manual transfer of engines over roller conveyors. As mentioned in paragraph 2.4. the manufacture of 250 HP and 350 HP engines should be deferred for the time being. Out of the other three, with 95% of the requirements expected to be for 130 HP engines and with high cost of tooling, it is felt that in the first instance, in the interest of economic viability, the plant should concentrate on production of only 130 HP engines.

7.2. The demand and supply position for 130 HP diesel engine on the basis of above suggestion for Alt.I and Alt. II rates of growth are shown in Tables 1 and 2 on pages 29 and 31 .

TABLE 3 : DEMAND AND CAPACITY PROJECTIONS FOR 130 HP DIESEL ENGINES - ALT. I

YEARS	DOMESTIC	EXPORTS	TOTAL	Maximum Domestic Production (BMC)	Demand to be met by Imports/AKMOSAN Project Alt. I
1983	19387	1939	21326	10000	11326
1984	20138	2014	22152	10000	12152
1985	21009	2101	23110	10000	13110
1986	25830	2583	28413	10000	18413
1987	27365	2737	30102	10000	20102
1988	28908	2891	31799	10000	21799
1989	30537	3054	33591	10000	23591
1990	32255	3226	35481	10000	25481

TABLE 4 : DEMAND AND CAPACITY PROJECTIONS FOR 130 HP DIESEL ENGINES - ALT. II (MINIMUM DEMAND)

YEARS	Domestic	Exports	TOTAL	Maximum Domestic Production(BMC)	Demand to be met by Imports/AKMOSAN Project
1983	19387	1939	21326	10000	11326
1984	20138	2014	22152	10000	12152
1985	21009	2101	23110	10000	13110
1986	21861	2186	24047	10000	14047
1987	22771	2277	25048	10000	15048
1988	23641	2364	26005	10000	16005
1989	24541	2454	26995	10000	16995
1990	25475	2548	28043	10000	18043

7.3. It will however be crucial for a detailed consideration to be given to the reasons for non-utilisation of the full capacity of BMC and to ensure that not only are they dealt with, to enable BMC to reach its rated output, but also that the same reasons do not vitiate the plans of AKMOSAN to effectively develop its production capability and capacity and be able to sell its products. These will include adequate finances both, foreign exchange and local, and electric power.

7.4. An emphasis on creation of marketing organisation to promote exports is essential. A nucleus of one or two persons could be provided even now to continually study trends of design and technology in Europe in the context of demand in Turkey's natural markets for exports to the Middle East and other Islamic countries.

7.5. A very close watch on steps to ensure adequate and timely supply of castings and forgings will be necessary to avoid locked-up utilized costly machinery and assembly equipment.

7.6. Training of engineers, technicians and workers in the licensors plants and offices will require very close monitoring. Particular attention is recommended for training of production, industrial, quality control and design engineers.

7.7. A continuous watch on the extent of local content versus imported content is recommended. The increase of local content at present planned is as under:

1981	7%
1982	24%
1983	51%
1984	70%
1985	90%

7.8. An organisation to encourage and monitor the development of ancillary industries to feed AKMOSAN will be essential. It is recommended that full use may be made of the computerised components and process data .bank developed

by TSKB as a part of their contribution to the Capital Goods Development Project.

7.9. With the above background it is recommended that TÜMOSAN should go ahead with its project to ultimately produce 24.000 engines on 2 shift basis subject to the following modifications:

(i) it should manufacture in the first instance only 130 HP engines and go into the question of manufacture of other engines only after detailed market investigations which may be taken up in 1984-1985.

(ii) the actual purchase of machinery and plant must be phased to suit actual requirement. While one each of the special purpose machinery and assembly of engines will be necessary, a close look at all general purpose machines where the requirements are more than one should be undertaken to ensure optimum utilisation of all assets. (It is understood that TÜMOSAN management has already initiated action on these lines).

This will mean that the physical capacity in early years will be less than 24.000 p.a. and consequently, capacity utilisation will be high.

(M.M.Luther)

Chief Technical Adviser

ANNEX I

MARKET RESEARCH

1. DESCRIPTION AND DEVELOPMENT OF THE SECTOR

The engines to be produced by the TÜMOSAN's Truck and Heavy Truck Diesel Engine Project shall be used in the vehicles of the automotive industry, for this reason, an over-all consideration of this industry will be helpful.

State Planning Organisation(SPO) uses the term"Road Vehicles Manufacturing Industry(RVMI)" instead of the term"automotive industry" which comprises, beside others, trucks, light trucks, buses, minibuses, passenger cars, cross-country vehicles, associated parts and components and the parts and components for overland vehicles and tractor engines.

RVMI is a driving sector for the manufacturing industry and the economy as a whole with the sub-suppliers it creates and with its direct and indirect services on the other industrial branches. It can be stated that no other sector requires as much diversified parts and sub-suppliers as the automotive industry. Establishment and development of other branches of the manufacturing industry which requires advanced technology will be supported by the

realization of investments related with engines, transmissions, control and safety systems and by the gradual increase of local content. Cheap and efficient system of overland transportation reduces the transport costs, realizes, proportionally, early structural interdependence between the industrial branches and facilitates the marketing of the products. In short, the automotive industry bears great importance as a driving sector for economic development.

Including the automotive industry, the question of in how many year an industrial branch will abandon its assembly character and become a substituting industry depends on various factors.

First factor is related with the technical and economic characteristics of an industrial branch(1), which factor should be investigated in no less than a 20-year-period. First commercial enterprises in Turkey appeared in the years 1948-50. Great demand which appeared between 1950-1959 in this connection was met by imports. However, the amount of foreign exchange allocated for this purpose fell short of meeting the demand. By way of

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(1) Prof. Dr. M.Hiç. "Economic Aspects and Problems of Turkish Automotive Industry" 1973,p.21.

liberation, abundant motor vehicles entered Turkey in 1950, but importing of said vehicles was largely restricted later-on due to foreign exchange shortage of 1954. The circumstances necessitated local manufacturing and assembly. Private sector favoured this field which started out, like similar ones in the world, partly as local-foreign partnership and partly as establishment of assembly plants under licensee which afterwards would be gradually transformed into a manufacturing industry by developing the local sub-suppliers as well.

Government policy, as second factor, played an important role in this subject, which approved of, effected necessary arrangement, developed related regulations and made possible the realization of vehicle assembly industry. Due to the foreign exchange deficiency of 1954, a large spare-parts shortage appeared. First steps were taken at the time towards manufacturing, initially by simple workshops, of such parts which were needed but could not be imported, and some organizations were founded. "Türk Willys Overland Ltd. Partnership" was the first in this series which started out by assembling

jeeps and pick-ups for the Army. The next was "T.O.E" firm which started assembling trucks and tractors in 1955. Establishment of "Otosan" and Çiftçiler" firms followed in 1959 (2).

Significant developments in the automotive industry starts after 1960 with the introduction of Planned Development. Between 1960-65, Uzel, TZDK(Turkish Agricultural Supply Organization), Chrysler, GENOTO, BMC, Çelik Montaj, Bisan and Otobüs Karoseri Sanayii firms joined the automotive industry as asseblers of trucks, light trucks, busses, automobiles, motorcycles and tractors.

Significant developments took place in this period both in production capacity and vehicle population. 1965-70 period was one in which prohibition started against automotive product imports and in which local production gradually defined the effective demand for vehicles. MAN, Karsan, Otomarsan, Oto-yol, Beldesan, Tofaş and Oyak-Renault were enterprises which joined the automotive

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(2) SPO RVMI. Report of Specialized Commission for Fourth 5-year Plan. Feb. 1977, p.4-5.

industry(3). During 1970-75 period, localization efforts were increased and both in vehicle production and population important developments were effected (in spite of the adverse effects of Finance Code numbered 1318, which was issued in 1970). The names and products manufactured as of 1975-end, by main producer firms are given in Annex 1, production capacities of truck, pickup, bus, min and midibus producers in Annex:2, and production figures between 1974-78 for truck and bus in Annexes: 3 and 4.

"Assembly Industry Directions"of 1964 played a part in the increase of local content. Said Directions aims at regulating the assembly activities and transforming them, in stages, into manufacturing industries. Succeeful models in this regard were seen in spite of various bottlenecks. Together with the development of local suppliers, a local content has been achieved in 1975 in vehicle production that can be considered high. In 1960's, local content consisted of assembly, labor,seat, international furnishing, tyre, accumulator and painting. In 1975's the ratios were : 67% in automobiles, 60% in minibuses, 65-75% in busses and 60% in trucks and light trucks. The local content objectives

(3) "TSKB" Research on Automotive Industry, Apr. 1977 p.4.

of the Ministry of Industry and Technology for 1978 are: 90% for automobiles, 75% for minibusses, trucks and light trucks, 75-80% for buses and 57% for truck-tractors (4). The main cause preventing the local content from increasing further is the postponement of local manufacturing of engines and transmission and no big HP engine production, excepting BMC firm.

2. PLACE OF MOTOR INDUSTRY IN DEVELOPMENT PLANS

In First Five Year Development Plan(FFYDP, 1963-67), internal combustion engines were considered among the machines, tools and equipment to be manufactured in the first plan period. The plan mentions of the existence of 900 diesel-engine production capacity, as of 1962, for engines up to 15 HP with 80% local content, of the surplus capacity of the dockyards and facilities of Naval Forces, Maritime Bank and State Railroads which are to be utilized for manufacturing of heavy diesel engines starting from 1963, and of the establishment of a joint plant as most of the parts for other gasoline and diesel engines will be manufactured collectively(5)

(4)SPO-RVMI-Specialized Commission Report 1977, p.6

(5)SPO-SFYDP p.519.

Second Five Year Development Plan(SFYDP, 1968-72) states that local manufacturing of engines and transmissions shall be encouraged and realized(6). It is also foreseen that the demand for engines and gera-boxes of overland vehicles and agricultural implements shall be met by local production towards the end of the period.(7).

Third Five Year Development Plan(TFYDP, 1973-77) considers the production of diesel engines for automotive industry among important investment items(8) and speaks of a high level importing of engines and intermediate goods since it is expected that the investments to be effected in the Third Plan Period for local production of engines and gear-boxes, which is the basic problem of automotive assembly industry, shall come into force with full capacity only after said period(9) and states that the public, private, third sector (Institutions,Trusts etc.), and the workers abroad shall take part in organizing for the realization of projects related with engines and transmissions.(10).

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(6) SPO-SFYDP p.519

(7) ibid. p.413

(8) SPO-TFYDP p.291

(9) ibid. p. 510

(10) ibid. p. 512

In connection with TFYDP, 1973 Program states that a partnership shall be established among private and third sectors and workers abroad and under the leadership of Machinery and Chemical Industry Inc. to manufacture engines and transmission for vehicles, agricultural tractors and some construction machines, and that this new partnership shall carry out the engines and transmissions projects entrusted with the Machinery and Chemical Ind. by 1972 Program(11).

1974 Program states that heavy industry equipment project and diesel engines industry, which will occupy an important place among investment goods industries could not be realized the former due to the failure in bringing the project studies to a sufficient level, and the latter due to failure in settling the organization problems (12). 1975 program states that among the manufacturing industries priority is given to investment goods and basic intermediate goods industries, that the related projects should be given great care and that the studies should be expedited for the projects which have the possibility of realization, and that for the others, which include diesel engines as well, studies should be completed. Another statement in the same program rads :"Studies have been completed for

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(11)SPO-1973 Program p.110.

(12) SPO - 1974 Program p. 144

diesel engine(vehicle type) and transmission industries but the related investments could not be realized"(13). "Studies shall continue, without any time loss, to realize the diesel engine and transmission industries which bear impoetance in directing the automotive industry according to the country's realities. Such studies shall be completed within the framework of the Third Plan".(14). 1976 Program repeats the statements of the previous Program. 1977 Program states that " Engine and transmission projects shall be completed by TÜMOSAN, and their application shall be started within a year" (15).

FFYDP states : "Vehicle motor and transmission manufacturing and related sub-suppliers have not yet been established to a satisfactory extent, and foreign dependency of the automotive sector continues" (16) . "It is the principle that engines and transmission

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(13) SPO- 1975 Program p.168.

(14) ibid. pp. 170-172

(15) SPO-1977 Program p.73

(16) SPO-FFYDP, p.444

equipment will be locally produced under the leadership of public sector. Diesel engines and transmission and rear axles projects of TÜMOSAN will be rapidly developed and realized.(17).

While the emphasis given to the diesel engine projects is such as described above, the actual developments in this field can be summarized as follows: Engine and transmission industry could not, unfortunately, be realized due to various reasons, BMC firm was the first to manufacture diesel engines by machining cylinder blocks and using the parts provided from sub-suppliers (18). In 1970, the engine machining and manufacturing facilities of the firm have been enlarged for an annual production of 10.000 engines and was transferred into a new building which was planned for a capacity of 20.000 units. In this the first and the only diesel engine plant was established which incorporates various engine parts machining lines, led by engine block and cylinder head lines, engine assembly lines, test standards and adjustment equipment and which produces diesel engine for the automotive industry between 52-145 HP range.

(17)ibid,p.446 (18) Ziya Özkan"Diesel Motor Industry in Turkey" p.4.

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

TRUCK DEMAND FORECASTS (SITC : 782.1)

YEARS	TÜSTAŞ	RVMI(SCR)	B.Ü.	TSKB		MAT	DESIYAB
				(2)	(1)		
1976	19.855	38.830	-	-	-	-	-
1977	20.405	46.230	19.300	18.239	16.116	26.440	15.100
1978	21.505	49.930	20.900	19.278	19.350	30.200	16.273
1979	23.100	55.280	22.600	21.474	23.342	33.550	17.532
1980	24.475	63.360	24.500	23.970	24.514	37.100	18.876
1981	25.960	68.780	26.600	26.780	28.841	40.750	20.315
1982	28.270	76.740	27.800	26.817	32.926	44.600	21.855
1983	-	-	31.200	-	-	48.650	23.503
1984	-	-	33.700	-	-	52.850	25.266
1985	-	-	36.500	-	-	57.200	27.153
1986	-	-	-	-	-	-	29.171
1987	-	-	-	-	-	-	31.331
1988	-	-	-	-	-	-	33.641
1989	-	-	-	-	-	-	36.114
1990	-	-	-	-	-	-	38.760
	-		-				

B.Ü.:Boğaziçi University.
TSKB : Turkish Industrial Development Bank.
MAT :Motor Vehicles Trade Co.
DESIYAB : State Industrial and Labor Investment Bank.
RVMI : Road Vehicle Manufacturing Industry (SPO).
* Shown in this table for ease of comparison.

ANNEX 2

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

TRUCK PRODUCTION (SITC : 782.1)

FIRMS	MAKE	MODEL	G.V.W.	HP	1974	1975	1976	1977	1978
GENOTO	Bedford (3,5 t)	KBC-10	5.690	74	1.056	1.308	2.208	2.232	840
	"(7,5 t)	K6EJR D.12200	12.200	112	1.055	780	1.469	1.596	804
TAŞIT SAN.	Leyland	(Ç) 6x4	18.750	150	237	235	Stopped production		-
OTOSAN	FORD	FM 600	12.200	115	3.201	4.207	5.283	-	-
		D.1210	12.200	115	-	-	-	5.998	4.180
OTOYOL	FIAT	50 NC	5.000	81.5	82	670	1.250	1.637	898
	"	130 NT	26.000	158	-	-	201	463	-
	"	(Ç) 684 N	32.000	200	12	-	-	-	-
	"	(Ç) 684 T.	32.000		162	150	-	-	-
	"	(Ç) 697 T	38.000	260	-	205	408	428	579
TOE	INTER.	1800-151	10.950	135	18	-	-	-	-
	"	1800-205	11.400	135	162	204	1.040	1.035	900
	"	1800-206	17.900	135	97	246	-	-	-
M.A.N.	MAN.	520 H	11.500	126	1	1	-	-	-
	"	520 HN	15.800	145	919	934	790	325	1.204
	"	19190HM	18.800	168	1	1	221	262	-
	"	(Ç) 13190-HS	26.400	190	-	43	120	26	-
	"	(Ç) 26256 DFS	36.000		-	1	-	-	-
CHRYSLER	DODGE	PD-600	10.500	110	876	1.755	2.805	2.029	491
BMC	BMC	TM-100	7.100	120	135	246	249	-	-
	"	TM-140	11.000	120	2.073	3.103	3.853	3.753	2.895
	"	TM-150	12.334	120	503	482	778	767	-
TOPLAM (TOTAL)					10.590	14.571	20.495	20.551	12.791

(Ç) Trailer G.V.W. : Gross vehicle weight in kg.

Source: 1- FFYDP, RVMI-SCR
2- The Ministry of Industry and Technology (MIT)
3- SPO

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

BUS PRODUCTION (SITC: 783.1)

FIRMS	MODEL	H.P.	1974	1975	1976	1977	1978
OTOMARSAN	12R-43 Seats	170	780	920	918	715	667
	10R-35 Seats	130	148	126	145	163	
	0309 Midibus	85	-	-	20	212	
MAN	590 HO	168	87	106	176	53	230
	445 HO	126	35	55	24	47	
OTOBÜS	M 200 R11-45 Seats		8	2	-	-	?
KAROSERİ	M 200 E11-45 Seats		4	-	-	-	?
TOTAL			1.062	1.209	1.283	1.190	897

Sources: 1) FFYDP, RVMI-SCR
2) MIT
3) SPO.

ANNEX 4

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

PRODUCTION CAPACITIES IN 1975 AND PLANNED ADDITIONAL CAPACITIES FOR TRUCK AND BUS

FIRMS	TRUCK			BUS		
	Certified capacity (*)	Installed Capacity (***)	Planned additional capacity	Certified Capacity (*)	Established Capacity	Planned additional capacity
GENOTO	4800	4800	(1982) 2200	-	-	-
OTOSAN	4000	4300	(1983)11100	-	-	-
OTOYOL	200	1200	-	-	-	-
TOE	1000	1000	(1980) 2400			
MAN (ERCANLAR)	1500	1500	11000(**)	250	250	2000
CHRYSLER	3000	3000	-	-	-	-
BMC	4500	10000	-	-	-	-
OTOMARSAN	-	-	-	700	1200	-
EGE OTOMOTIV	-	-	7000			1500
ANADOLU ENDÜSTRİ	-	-	10000	-	-	-
KARSAN	-	-	7500	200	200	-
TOTAL	19000	25800	51200	1150	1650	3500

Sources : 1- FFYP, RVMI(SCR)
2- MIT

* : Certified by Chamber of Industry on the basis of actual production.
** : Also includes pick-ups.
*** : Quoted by manufacturers.

DEMAND FORECAST FOR DIESEL TRUCK ENGINES

(DESIYAB 1)

YEARS	Truck Load Traffic Forecast (Million Tons X Km)	Truck Load Traffic Forecast (1000 Tons/Km)	Truck-Pickup Population Forecast (Units)	New Demand (Units)	Replacement Demand (Units)	Total Demand (Units)	Diesel Truck (engine) Demand (Units)
1976	30,628	138	221,942				
1977	33,546	139	241,338	19,396	15,687	35,083	14,117
1978	36,667	140	261,907	20,569	17,024	37,593	16,541
1979	40,013	141	283,780	21,873	18,446	40,319	17,740
1980	43,580	142	306,901	23,121	19,949	43,070	18,950
1981	47,404	143	331,497	24,596	21,547	46,143	20,301
1982	51,495	144	357,604	26,107	23,244	49,351	21,714
1983	55,873	145	385,331	27,727	25,047	52,774	23,221
1984	60,558	146	417,781	29,450	26,961	56,501	24,860
1985	65,570	147	446,054	31,273	28,994	60,267	26,517

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY ANNEX 7

DEMAND FORECAST FOR TRUCK DIESEL ENGINES

(DESIYAB 2)

YEARS	Diesel Truck Pop. Forecast (Units)	New Demand	Replacement Demand (Units)	Total Demand (Units) DESIYAB 2
1976	94,361			
1977	102,780	8,419	6,681	15,100
1978	111,787	9,007	7,266	16,273
1979	121,426	9,639	7,893	17,532
1980	131,739	10,313	8,563	18,876
1981	142,774	11,035	9,280	20,315
1982	154,581	11,807	10,048	21,855
1983	167,215	12,634	10,869	23,503
1984	180,733	13,518	11,748	25,266
1985	195,198	14,465	12,688	27,153
1986	210,675	15,477	13,694	29,171
1987	227,236	16,561	14,770	31,331
1988	244,955	17,719	15,922	33,641
1989	263,915	18,860	17,154	36,114
1990	284,202	20,287	18,473	38,760

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

ANNEX 8

CLASSIFICATION BY TONNAGE OF DIESEL TRUCK POPULATION

YEARS	4-Ton	% Share	5-9 Ton	% Share	10-11 Ton	% Share	TOTAL
1966	1,091	3,4	29,484	92,3	1,365	4,3	31,940
1967	461	1,2	36,598	94,9	1,487	3,9	38,546
1968	473	1,1	42,865	95,7	1,445	3,2	44,783
1969	655	1,3	49,569	95,9	1,463	2,8	51,687
1970	574	1,0	51,057	94,4	2,469	4,6	54,100
1971	702	1,3	53,184	93,6	2,907	5,1	56,793
1972	896	1,4	57,205	91,9	4,162	6,7	62,263

Source: THSY-1976 p.71.

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

ANNEX 9

DEMAND FORECAST BY HP FOR TRUCK DIESEL ENGINES

(DESIYAB)

YEARS	85 HP	130 HP	168 HP	TOTAL
1978	244	14,646	1,383	16,273
1979	263	15,866	1,403	17,532
1980	283	16,988	1,605	18,876
1981	305	18,182	1,828	20,315
1982	328	19,451	2,076	21,855
1983	353	20,800	2,350	23,503
1984	379	22,234	2,653	25,266
1985	407	23,759	2,987	27,153
1986	438	25,379	3,354	29,171
1987	470	27,101	3,760	31,331
1988	505	28,931	4,205	33,641
1989	542	30,877	4,695	36,114
1990	581	32,946	5,233	38,760

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

STATISTICS FOR BUS POPULATION

YEARS	Bus Pop. (Including Minibusses)	Diesel Bus Pop.	Percentage of Diesel Bus, Minibus Pop.	Passenger Transport Million Persons-km.	1000 Passengers Per Bus	GNP at 1968 Prices Million TL	Percentage of Diesel Bus Pop.	Percentage of Diesel Bus Pop.
1956	7.780	1.652	21.2	12.971	1.667	58.022		
1957	8.064	2.083	25.8	8.906	1.104	62.895		
1958	8.001	2.225	27.8	8.886	1.111	65.844		
1959	8.854	2.487	28.1	9.969	1.126	68.521		
1960	10.942	2.899	26.4	10.880	994	70.869		
1961	13.916	3.448	24.8	14.131	1.051	72.286		
1962	16.388	4.027	24.6	15.590	951	76.754		
1963	19.219	4.844	25.2	19.369	1.008	84.188		
1964	20.157	5.748	29.5	22.667	1.125	87.619		
1965	21.914	6.264	28.4	24.931	1.138	90.365		
1966	22.771	6.737	29.6	25.948	1.140	101.204	56	71
1967	29.136	7.474	25.6	32.049	1.101	105.461	54	77
1968	33.273	8.199	24.6	41.342	1.243	112.493	51	78
1969	35.864	9.777	27.2	39.571	1.103	118.594	61	80
1970	36.896	10.874	29.5	41.311	1.120	125.245	68	82
1971	39.460	11.950	30.3	43.898	1.112	138.582	71	82
1972	44.063	13.159	29.9	50.207	1.139	149.112	71	82
1973	51.463	14.848	28.9	57.440	1.116	137.309	73	

Sources: TKSY-1969,1970,1976.
General Directorate of Highways.
STP-early Programs.

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

DEMAND FORECAST FOR DIESEL BUS ENGINES

(DESIYAB 1)

YEARS	Passenger Transportation Forecast (Million Persons-km)	1000 Persons Per Bus	Bus-Minibus Pop.Forecast (Units)	New Demand (Units)	Replacement Demand (Units)	Total Demand (Units)	Diesel Bus Engine Demand Forecast (Units)
1977	83,317	1,126	73,994				
1978	90,790	1,127	80,559	6,565	5,236	11,801	3,450
1979	98,787	1,128	87,577	7,018	5,693	12,711	3,813
1980	107,344	1,129	95,079	7,502	6,180	13,682	4,105
1981	116,500	1,130	102,097	8,018	6,701	14,719	4,416
1982	126,296	1,131	111,668	8,571	7,258	15,829	4,749
1983	136,778	1,132	120,829	9,161	7,854	17,015	5,105
1984	147,994	1,133	130,621	9,792	8,490	18,282	5,485
1985	159,995	1,134	141,089	10,468	9,171	19,639	5,892

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DEMAND FORECAST FOR DIESEL BUS ENGINES (DESIYAB 2)

YEAR	Diesel Bus Pop. Forecast (Units)	New Demand (Units)	Replacement Demand (Units)	Domestic Demand DEsiyab-2	Domestic Demand Desiyab-1	Domestic Demand - Exports (Units)	Bus Production Target (Units)	Effective Demand (Units)
1978	23,367	1,946	1,519	3,465	3,540	3,740	3,175	3,175
1979	25,449	2.082	1,654	3,736	3,813	3,926	3,540	3,540
1980	27,676	2,227	1,739	4,026	4,105	4,276	4,535	4,176
1981	30,060	2,384	1,954	4,338	4,416	4,588	5,180	4,588
1982	32,610	2,550	2,120	4,760	4,749	4,920	5,690	4,920
1983	35,339	2,729	2,297	5,026	5,105	5,276	5,990	5,276
1984	38,269	2,920	2,487	5,407	5,485	5,657	6,290	5,657
1985	41,383	3,124	2,690	5,814	5,892	6,064	6,590	6,064
1986	44,726	3,343	2,907	6,250		6,500	6,890	6,500
1987	48,303	3,577	3,140	6,717		6,917	7,190	6,917
1988	52,131	3,828	3,389	7,217		7,467	7,490	7,467
1989	56,226	4,095	3,655	7,750		8,000	7,790	7,790
1990	60,608	4,382	3,940	8,322		8,572	8,090	8,090

Source: SPO, SCR-RVMI, Feb.1977 (Export Projection p.39, Production Targets p.35).
NOTE : Exports have been projected a 250 units for 1978-79. Same amount of exports were maintained after 1982, as no projection was made for the period following this year. Production targets are given till 1982, after which it has been assumed to increase 300 units per year. As gathered from the Ministry of Industry and Technology, having obtained encouragement certificate. Ege Automotive Industry will reach full capacity in 1982 with 1000 units, which has accordingly been included in the production target figures above.

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

ANNEX 13

STATISTICS FOR TRUCK AND BUS POPULATION

YEARS	TRUCK(Units)	Bus(Units)
1966	47931	12041
1967	56889	13332
1968	62616	13948
1969	69478	15529
1970	70730	15980
1971	73433	17140
1972	78920	18504
1973	89685	20340
1974	97050	21387
1975	108614	22928
1976	124569	24581
1977	143664	26261
1978	152334	27666
1979	162667	29313

SITC No. for trucks : 782.1

SITC No. for busses : 783.1

Source: State Institute of Statistics.

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

ANNEX 14

TRUCK DEMAND BASED ON FLEET BETWEEN 1966-1979

Linear regression

$T = 0.8937\ GNP - 43870$

$r = 0.97326$ $v = 9.3\%$

PROJECTION TO 1990

YEARS	Rate of Growth %	GNP Million TL 1968 Prices	Truck Pop. Projection	New Demand	Replacement Demand	Total Deman
1979	0.2	212567				
1980	0	212567				
1981	3.5	220006				
1982	3.5	227707	159632			
1983	3.5	235677	166754	7122	10839	1796
1984	3.5	243926	174127	7373	11318	1869
1985	3.5	252463	181756	7629	11812	1944
1986	5	265086	193037	11281	12547	2382
1987	5	278341	204883	11846	13317	2516
1988	5	292257	217320	12437	14126	2656
1989	5	306870	230380	13060	14975	2803
1990	5	322214	244093	13713	15866	2957

SITC No. for trucks: 782.1

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

ANNEX 15

TRUCK DEMAND BASED ON SEMI-LOGARITHMIC PROJECTION

$$\ln T = 9.9388 + 9.358 \times 10^{-6} \text{ GNP}$$
$$r = 0.98832$$

YEARS	Rate of Growth %	GNP Million TL (1968 prices)	Truck Population Projection	New	Demand Replc.	TOTAL
1979	0.2	212567				
1980	0	212567				
1981	3.5	220006				
1982	3.5	227707	174543			
1983	3.5	235677	188060	13517	12224	25741
1984	3.5	243926	203154	15094	13205	28299
1985	3.5	252463	220051	16897	14303	31200
1986	5	265086	247645	27594	16097	43691
1987	5	278341	280353	32708	18223	50931
1988	5	292257	319350	38997	20758	59755
1989	5	306870	366153	46803	23800	70603
1990	5	322214	422696	56543	27475	84018

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY — ANNEX 16

TRUCK DEMAND PREDICTED BY POWER CURVE ANALYSIS BASED ON TRUCK POPULATION BETWEEN 1966-1979

$T = a\ GNP^b$

$a = 4.14671 \times 10^{-3}$

$b = 1.415823$

$r = 0.98157$ $\quad v = 8.44\%$

YEARS	Rate of growth in GNP %	GNP Million TL (1968 prices)	Truck pop. projection	DEMAND		
				New	Replacement	TOTAL
1983	3.5	235677	167477	7962	10886	18848
1984	3.5	243926	175836	8359	11429	19788
1985	3.5	252463	184612	8776	12000	20776
1986	5	256086	197815	13203	12858	26061
1987	5	278341	211964	14149	13778	27927
1988	5	292257	227122	15158	14763	29921
1989	5	306870	243366	16244	15819	32063
1990	5	322214	260772	17406	16950	34356

NB: 1) Replacement demand is calculated as 6.5% of the population which is equivalent to assuming a useful life 15 year for vehicle.

2) SITC No. for trucks : 782.1

DISTRIBUTION OF DOMESTIC DEMAND INTO HP RANGES FOR TRUCK DIESEL ENGINES

YEARS	DEMAND IN UNITS, FOR ENGINES OF			TOTAL DEMAND (UNITS)
	85 HP	130 HP	168 HP	
1983	276	16288	1840	18405
1984	289	16931	2020	19240
1985	302	17595	2212	20109
1986	374	21702	2869	24965
1987	398	22961	3186	26545
1988	424	24288	3530	28242
1989	451	25692	3906	30049
1990	480	27173	4315	31968

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

ANNEX 18

DEMAND FOR BUSSES

Based on 1966-1979 bus population figures

T = 0.1372 GNP - 1488.1 Linear Regression

r = 0.9934 v = 3.35%

YEARS	Rate of Growth %	GNP Million TL (1968 prices)	Bus Population	DEMAND			DESIYAB PROJECT
				New	Replacement	Total	
1980	0	212567					
1981	3.5	220006	28697				
1982	3.5	227707	29753	1056	1934	2990	4760
1983	3.5	235677	30842	1094	2005	3099	5026
1984	3.5	243926	31976	1129	2078	3207	5407
1985	3.5	252463	33150	1174	2155	3329	5814
1986	5	265086	34882	1732	2267	4000	6250
1987	5	278341	36700	1818	2386	4204	6717
1988	5	292257	38610	1910	2510	4420	7217
1989	5	306870	40615	2005	2640	4645	7750
1990	5	322214	42720	2105	2777	4882	8322

NB. 1- Bus production targets and export projections not considered.

2- SITC number for buses 783.1.

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY
CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

ANNEX 19

Domestic demand for truck and bus based on GNP growth projections recommended by SPO (Alternative 1).

Truck population : T = 0.8937 GNP - 43870 (Linear regression).

Bus population : T = 0.1372 GNP - 1488.1 (Linear regression).

YEARS	Rate of Growth	GNP Million TL (1968 prices)	TRUCK DEMAND		BUS DEMAND		TOTAL DOMESTIC DEMAND
			New	Replace.	New	Repl.	
1980	0	212567					
1981	3	218949					
1982	3.5	226607					
1983	4	235671	8100	10839	1244	2005	22188
1984	4.5	246277	9479	11455	1455	2100	24489
1985	5	258590	11004	12170	1690	2209	27073
1986	5.5	272813	12711	12996	1951	2336	29994
1987	5.5	287818	13410	13868	2058	2470	31806
1988	5.5	303648	14147	14788	2173	2611	33719
1989	5.5	320348	14925	15758	2291	2760	35734
1990	5.5	337967	15746	16781	2417	2917	37861

Notes: 1) 10% export projection for trucks of 10-11 ton capacity not considered.

2) Average useful life for both truck and bus taken as 15 years.

Domestic demand for truck and bus based on GNP growth projections recommended by SPO (Alternative IV).

Truck population : T = 0.8937 GNP - 43870 (Linear regression)

Bus population : T = 0.1372 GNP - 1488.1 (Linear regression)

YEARS	Rate of Growth %	GNP Million TL (1968 prices)	TRUCK DEMAND		BUS DEMAND		TOTAL DOMESTIC DEMAND
			New	Replace.	New	Replace.	
1980	0	212567					
1981	3	218944					
1982	3.5	226607					
1983	4	235671	8100	10839	1244	2005	22188
1984	4.5	246277	9479	11455	1455	2100	24489
1985	5	258590	11004	12170	1690	2209	27073
1986	6	274105	13866	13071	2128	2348	31413
1987	6	290552	14698	14027	2257	2494	33476
1988	6	307985	15580	15039	2392	2650	35661
1989	6	326464	16515	16113	2535	2815	37978
90	6	346052	17506	17251	2687	2989	40433

Notes: 1) 10% export projection for trucks of 10-11 ton capacity not considered.

2) Average useful life for both truck and bus taken as 15 years.

Yayın ve Temsil Şubesi Matbaa Birimi 1981 ANKARA

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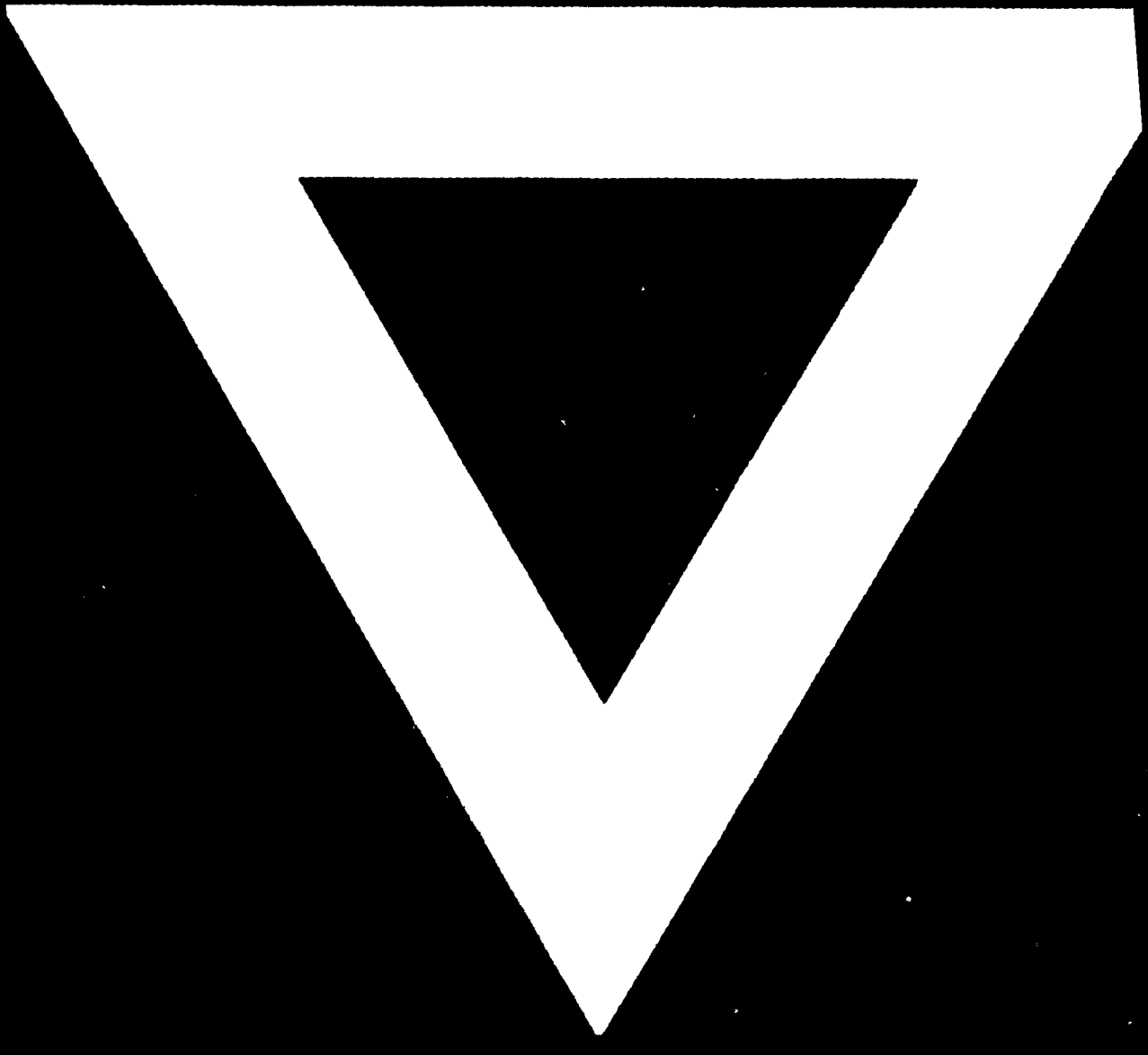

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