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EVOLUTION OF THE GREEK PETROCHEMICAL INDUSTRY

Submitted by the Government of Greece

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OUTLINE

EVOLUTION OF THE GREEK PETROCHEMICAL INDUSTRY

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T A B L E S

EVOLUTION OF THE GREEK PETROCHEMICAL INDUSTRY (1)

1. Outline of the Greek Petrochemical Product Demand

a. Fuels

As may be expected for an economy which is still in the stage of development and which has entered the stage of industrialization in some important scale only in the last ten years, while retaining a predominant agricultural character, Greece's consumption of petroleum-based products is dominated by its needs in fuels and chemical fertilizers. Table 1 attached, which gives the development in the consumption of principal fuels and feedstocks based on crude petroleum, shows that the consumption of petroleum products used as fuels has been growing very rapidly. This element is important because when a country lacks an indigenous cheap raw material for petrochemical production, such as petroleum or natural gas or domestic demand for products so large as to justify importation of intermediate stocks (e.g. naphtha) for further processing, petroleum refining becomes the only basis on which to start a petrochemical industry.

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(1) Strictly speaking "Petrochemical Industry" implies the processing of crude petroleum or the products of petroleum refining for the production of various chemical products. This paper, however, deals also with alternative sources of supply (e.g. ammonia from lignite) for the purposes of completeness as well as non-petroleum based chemicals that are technically or physically related to the country's petrochemical industry (e.g. chlorine going into VCM production).

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In the case of the petroleum products we have two factors which lead us to believe that the demand is going to rise equally as rapidly in the coming years as it has in the past decade: namely the fact that Greece's rapid industrialization will require increasing amounts of fuel oils to operate the new plants and secondly the fact that Greece is now entering the first stage of its passenger car development and has not reached the motor-car population customary in Western European countries.

b. Chemical Fertilizers.

In the case of fertilizers on the other hand, rapid introduction of new technologies in agriculture in the late fifties and early sixties has caused the demand for fertilizers and especially nitrogenous fertilizers to rise very rapidly. These technological improvements with existing conditions have been more or less exhausted while the supply of agricultural land in the country is relatively fixed. However, the country has embarked upon a long range program of land irrigation, which is expected to triple demand of irrigated land within this century. While therefore consumption for fertilizers will not increase as spectacularly as it has been in the recent past, we can look forward to a slower steady growth in fertilizer requirements as irrigation and the consequent switches from extensive to intensive cultivations will require increased dosages.

In Table 2 attached we are giving the Agricultural Bank of Greece and Ministry of Agriculture estimates of fertilizer requirements in Greece in the seventies.

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c. Plastics.

Manufacturing of plastics started in the early fifties and has since known very rapid growth although the industry is still dominated by a very large number of establishments of very small scale, suffering from the well-known problems of underfinancing, lack of technology, know-how and proper managerial methods. This fragmentation of the industry plus the smallness of the market in absolute terms have provided few significant outlets, domestically for any of plastics raw materials that constitute a necessary complenent of the petrochemical industry. Table 3 gives a breakdown of the consumption of plastics raw materials in Greece in recent years as well as forecasts for 1970 based on a 1965 survey by L. H. Manderstam and Partners.

d. Fibres.

The textile industry, one of the most advanced sectors in the Greek economy, has a long history and has been in recent years undergoing extensive modernization and rationalization. This industry has used predominantly cotton which is in abundant local supply as its raw material and has only recently entered the era of using synthetic fibres for textile products. However, consumption of synthetics is still in its infancy, as Table 4 indicates, and although there ought to be a substantial margin for rapid increase it is very difficult to predict in what stage consumption will require extensive domestic capacity for synthetics.

e. Rubbers.

The consumption pattern of synthetic rubber materials in

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Greece, (identical to the import movements since all domestic requirements are met by imports) does not show any outstanding development during the last ten years.

Footwear and misxellaneous industrial uses form a substantial share of the demand. Although the Pirelli tyre and tube factory commenced production in 1962, considerable quantities of tyres are still being imported.

The bulk of synthetic rubber raw material imported is of the Styrene-Butadiene Rubber (SBR) type and this most likely will continue to occupy its predominant position in the field. One report(2) has the domestic requirements for SBR in 1970 at the level of 6.000 - 9,000 TPY out of a total of 8,000 - 12,000 TPY.

Developments in the transport sector of the Greek economy and private car ownership will greatly influence the future of synthetic rubber in Greece.

f. Other Petrochemicals.

The domestic requirements for chemicals classified as petroleum derivatives (other than polymers) have risen substantially over recent years. Apart from a few products which are produced locally to a limited extent, all the needs are met through imports. Among the various classes of products the following deserve particular attention:

i. Detergents and surfactants.

Detergents have seemingly progressed in the Greek market rather swiftly, at the expense of soap, and continued growth

(2) L. H. Manderstam and Partners; "Survey of the Fertilizer and Petrochemical Industries in Greece; June 1965

is forseen. In this respect detergent alkylate requirements are expected to rise considerably. Other raw materials, like ethylene exide, alcohols etc. for the production of surfactants for the textile, leather and paper industry, are being used only in very small quantities.

ii. Solvents.

The main solvents in use are the lower alcohols, the chlorinated compounds, aromatics and miscellaneous other hydrocarbons (hexane, white spirits, etc.), The Greek market is rather limited amounting currently to 5.000 TPY(3). Future applications and customs duties developments will influence the rate of growth of this sector, generally expected to expand.

iii. Plasticisers.

The bulk of the requirements for plasticisers will originate from the processing of PVC and it is estimated that on the basis of the 15,000 metric tons PBC projection for 1970, the requirements for phthalate ester plasticisers would be of the order of 4,000 tons per year.(4)

2. Evolution of the Petrochemical processing industry in Greece

a. Supply of primary materials.

Greece has no known deposits of petroleum, natural gas or coal. The sole alternative domestic source of primary materials

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(3) Esso Pappas Estimates

(4) L. H. Manderstam and Partners: "Survey of the Fertilizer and Petrochemical Industries in Greece"; June 1965

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for petrochemical products is lignite. The only developed and extensive lignite deposit in Greece of a grade suitable for petrochemical processing, lies in Ptolemais in the North-Central part of the country. Barring unexpected discoveries therefore, imported cruce oil must constitute the basic long range raw material for the petrochemical processing industry.

b. Fertilizer Capacity.

In the chemical industry the fertilizer plants have the longest history in Greece. The first phosphate fertilizer plant went on stream in Greece in 1920 in Pireaus and is still today in operation producing at capacity 380,000 tons of fertilizers per year.

In 1964 the second nitrogenous fertilizers plant in Greece went on stream based on the production of ammonia from lignite. The Ptolemais plant is located on top of Greece's most developed lignite site, has an ammonia capacity of 95,000 tons per year and produces various types of fertilizers of the order of 295,000 tons per year.

Finally in 1966 a third fertilizer factory went on stream in Kavalla with an annual capacity of 250,000 tons of fertilizers including an ammonia plant with an annual capacity of 50,000 tons based on partial oxidation of crude oil.

The combined capacity of these three plants is of the order of 925,000 tons per year in various types of fertilizers, with a corresponding supply in plant nutrients of 265,000[5] metric tons

(5) Esso Pappas Estimates

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versus 1966 requirements of 260,000 metric tons in the country as a whole.

c. Refining

Late in 1958 the first refinery in the country went on stream in Aspropyrgos near Athens with a design capacity of 1.35 million metric tons per year which was subsequently raised to 1.8 million metric tons. Demand for petroleum products had outstripped the capacity of this refinery by the time its operation had started. Demand currently stands at 5.1 million metric tons per year, including sales of 1.5 million metric tons to aviation and international bunkers.(6)

d. Plastics.

In 1963 Dow Chemicals established the first plant aimed at supplying materials for the plastics industry in Greece with an original capacity of 3,000 metric tons of polystyrene - presently expanded to 5.500 -based on imported monostyrene. This plant is located about 40 miles from Athens.

3. The conception of the Thessaloniki petrochemical complex

In the early sixties the economy was faced with the following significant elements that played a role on the policy for the development of the petrochemical industry:

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(6) Esso Pappas Estimates

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a. a rapidly growing shortage in petroleum products

b. a rapidly growing shortage in fertilizer capacity and especially ammonia, and

c. the desire of the Government to create a pole of industrial development in the North of Greece in order to change the structure of the latter's agricultural economy and to counterbalance the tendency of the manufacturing industry to concentrate in the South and especially in Athens.

In discussions held with Mr. T. A. Pappas it was decided to study the possibility of promoting the establishment of a refinery in Thessaloniki as well as the creation of a number of petrochemical plants.

This study concluded on the feasibility of a petrochemical complex consisting of the following: a refinery, an ammonia plant, a steam cracker, a chemical solvents plant, a PVC plant, and a steam and utilities plant serving the above mentioned plants as well as those mentioned below.

Subsequently the following steps were taken to expand this basic group and enhance its viability.

Agreement with the National Bank of Greece, the Greek Chemical Products and Fertilizers Company and the Societé St. Gobain to establish their proposed fertilizer plant in Thessaloniki and link itself to ammonia produced there.

Ethyl Corporation agreed to establish a plant to be supplied with ethylene from the steam cracker as a raw material for the production of tetraethyl and tetramethyl lead as well as vinyl chloride monomer to be used as feedstock for the production of polyvinyl-chloride (PVC).

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Finally another agreement originally with a Greek businessman, provided for the establishment in Thessaloniki, as an integral part of the petrochemical complex, of a caustic and chlorine plant which would, among other things, supply chlorine for the Ethyl plant. The implementation of this agreement was later taken over by Esso.

4. <u>Technical and economic characteristics of the Thessaloniki hydrocarbon complex.</u>

Table 6 summarizes the characteristics of the Thessaloniki Hydrocarbon complex and the attached Graph 7 outlines the degree of its interdependence, its principal and products and its basic raw materials.

The basic plant in the complex is the refinery with a design capacity of 2.5. MMT per year of crude. It is a hydroskimming refinery with atmospheric and vacuum distillation and with a catalytic reforming unit, or Powerformer, for gasoline quality improvement. Esso's hydrofining process is used to remove sulphur from the light distillate products. The refinery design incorporates the latest features for low cost operation, such as in-line blending of products without the use of intermediate tankage, and for savings in fuel costs, the refinery is one of the most fully heat integrated in the world.

The ammonia plant has a production capacity of 105,000 tons per year of ammonia. The feed is naphtha from the refinery. The ICI catalytic reforming process is used to convert the naphtha, in the presence of steam, to hydrogen, Co and CO_2. After catalytic shift convertion of CO to CO_2, the CO_2, the CO_2 is removed from the synthesis gas in a Vetrocoke unit, which employes a solution of an arsenic salt for CO_2 absorption. The synthesis gas, consisting

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of nitrogen and hydrogen in proper proportions, is compressed to 300 atmospheres in two multi-service compressors, operating in parallel and driven by two 6,500 HP synchronous motors. Ammonia synthesis takes place in a catalytic converter under controlled temperature conditions, and the product is stored at atmospheric pressure in a refrigerated storage tank at -33°C.

A high degree of thermal efficiency is obtained by using the ICI steam reforming catalyst.

The solvents unit also uses naphtha feedstocks from the refinery to produce hexane, white spirits and special boiling point naphthas. It is principally a distillation unit with a hydrogenation step for saturation of aromatics in the feed to the hexane section of the unit and a treating step for quality improvement of white spirits. Total production capacity is 24,000 tons year of solvents.

The steam cracker, which also uses refinery naphtha as a feed, has a production capacity of 15,000 tons per year of ethylene. It is small in comparison to the giants now being built elsewhere in the world; however, its design incorporates very interesting efficiency features, such as the use of special alloy tubes for higher conversion levels from naphtha to ethylene and the use of simple furnace by on-stream decoking.

The electrolysis unit has a design capacity of 27,000 tons per year of chlorine with a corresponding production of almost 30,000

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tons per year of caustic soda. Facilities have also been provided in this plant for producing 14,000 tons per year of sodium hypochlorite, 2,000 tons per year of sodium sulphide and 11,000 tons per year of muriatic acid. The plant size was determined by the combined effects of Ethyl's requirement for chlorine, the Greek market's for caustic soda and the other inorganic products, as well as the planned production of polyvinyl chloride in the hydrocarbon complex. The plant uses rock salt brine as a feed. The electrolysis takes place in mercury cells designed and furnished by the Olin-Matheson Company in the United States. The cells are the largest of their kind and incorporate new, high capacity features recently developed by Olin- Mathieson and used commercially here for the first time outside of Olin's own plants.

The polymerization unit for the production of polyvinyl chloride, PVC, has a design capacity of 12,000 tons per year, and is expandable to 20,000 tons per year with minimum investment. The plant is designed for the Mitsui process. It will process vinyl chloride monomer produced by Ethyl Hellas and will make suspension type resins in grades commonly used by plastics fabricators in Greece.

These plants and processes along with the common steam, power and water systems, represent an industrial undertaking of a complecity seldom encountered anywhere, in terms of simultaneous construction and start-up.

The start-up of the utilities systems in early 1966 was followed by the refinery start-up in April. Crude was fed to the pipestill in April 4 and six days later, on April 10, all products

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were going to storage on specification.

In early May, feed was introduced into the ammonia plant. Because of the need to prepare catalysts and to commission a series of process steps, the initial start-up had to proceed in a stepwise manner and took considerably longer than the refinery start-up. On May 28 the first ammonia went to storage, and within a few weeks the plant was operating at 80% of capacity, supplying the fertilizer plant of Chemical Industries of Northern Greece Company, which was also completed on schedule, to supply fertilizer requirements for the agricultural season starting in the Fall of 1966. In spite of several mechanical and operating problems, the overall performance of the ammonia plant has been very satisfactory, with extended periods of operation at 99% of capacity.

During June and July the solvents unit was commissioned with essentially no operating difficulties.

The electrolysis plant and the PVC units were mechanically completed in October and operating personnel were ready for start-up activities.

Finally in February 1967, the Ethyl plant went on stream allowing simultaneous full-scale operation of the Steam Cracker, Chlorine and PVC units and the entire hydrocarbon complex was thus in normal operation only 30 months after ground breaking.

One thing that should be noted about this hydrocarbon complex is that while the refinery, ammonia, fertilizer and Ethyl plants are designed with capacities allowing efficient and compe-

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titive operations by curent technology, the caustic and chlorine, ethylene, solvents and PVC plants are considerably below minimum efficient capacity envisaged by current technologies. As an illustration one could state that while steam crackers are currently designed for 300 thousand tons per year output, the Greek plant is 1/20 of that capacity. These plants have been designed so that their capacity can be easily expandable; Greek requirements today, however, are only a fraction of even the current capacity of some of these plants and therefore expansion cannot be anticipated for years. On the export side, the high transport cost of many of the petrochemical products involved and the small size of the plants make exports extremely difficult, although, as will be seen further on, considerable export achievements have been accomplished. The first element to keep in mind is that in the case of many of these plants the construction was a pre-investment in anticipation of Greece's future requirements and its need to acquire the necessary technology.

5. Developmental effects of the Thessaloniki Hydrocarbon complex on the Greek economy.

a. Effects on investments.

Table 8 outlines the incidence of the Thessaloniki hydrocarbon complex on total investment, manufacturing investment and foreign investment under Law 2687, which is the country's basic foreign investement incentive. In this significant case most of the capital for the Thessaloniki hydrocarbon complex came from foreign countries, and represents the largest single such investment in the country's ten year-old history of attracting foreign busines, especially in manu-

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facturing. Needless to say that the effect on manufacturing investment in the economy of Northern Greece is even greater although harder to estimate.

What is more important, however, is that the hydrocarbon comlex has laid the foundation for further investment in the future. Its requirements for importing about 45 thousand tons of salt per year, which far exceeds the country's current capacity, have assured a potential outlet for a salt plant, which is now being contemplated. A sulphur plant, which will reach 10 thousand tons of output per year is under consideration for the refinery. Furthermore, the country has acquired the basic manufacturing ability for the production of a whole range of petrochemical products necessary in the modern fibre, plastics and rubber industries. These possibilities, however, have to be viewed with a great deal of caution because the country's consumption in these products is still very small by international standards while duty protection is small and rapidly diminishing as a result of Common Market Association. A rush to establish capacity for these products may lead to uneconomical sizes.

b. Effects on Manufacturing income and output.

The Thessaloniki hydrocarbon complex is currently in the process of changing the entire structure of the manufacturing sector in Greece from consumer orientation to an intermediate product orientation. The incremental effects it exerts in this direction are shown in the comparison of the index of total industrial production and that of the petroleum and chemical industries for the years 1964 through 1966 (Table 9). It should be noted that most of the plants in

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Thessaloniki will reach normal operating levels in 1968 and their effect on output in that year will be even more pronounced than in 1967.

c. Balance of Payments Effects.

In terms of structural effects on the economy, the Thessaloniki hydrocarbon complex, benefits the balance of payments more than perhaps any other industrial unit. (Table 10). Approximately 30% to 40% of the total initial investment was spent locally. That means that about $35 million went to increase the country's foreign exchange reserves which at the end of 1966 stood at $276.3 million.(7)

Furthermore the country acquired export capacity in petroleum products and ammonia for the first time, assuring significant foreign exchange revenue for several years. The Ethyl plant is probably the first manufacturing enterprise in Greece not based on local primary resources, which is a 95% export industry. Finally the start-up the hydrocarbon complex means substantial foreign exchange savings on products which we hitherto imported.

d. Employment effects.

The petrochemical industry in general is a highly capital intensive activity whose effects on the employment and manpower situation must not be examined in terms of direct employment only, but also in terms of opportunities for acquiring highly complex processing skills, and multiplier employment generated in the community by the operation of these plants.

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(7) Bank of Greece

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In the case of many units in the hydrocarbon complex, Greek engineers and other professionals had no expereience whatever in their operation. Greek Engineers made about 50 training trips to similar industries in Jamaica, Aruba, Spain, Holland, Norway, Japan, Canada, the U.K. and the United States.

A number of engineers and technicians had to be brought in from abroad to start up the plants and train the Greek counterparts in their operation. At the peak the number in the Esso Pappas hydrocarbon complex alone reached about 90. However, many of the foreign technicians have already completed their task and left and it is expected that by the end of 1967 only 5 will still be in Greece. Total employment in the Thessaloniki hydrocarbon complex is in the order of 1100 persons with a high proportion of professionals and skilled technicians. For the town of Thessaloniki this has wide ranging social effects as well. It provides a solid professional middleclass to what was up to now an agricultural market center and export harbour. It provides an outlet for the graduates of the local University and other vocational schools, and it increases the incentives for other professionals, who up to now have concentrated in Athens, to live and seek career opportunities in the North.

It is usually accepted that a basic manufacturing job in a community creates the opportunity for another four additional jobs in the same community. If we accept an average family size of three that means that the creation of this hydrocarbon complex affected a population of 16,500 people.

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e. Effects on regional industrial infrastructure.

An indispensable condition for industrial development in a region is the existence of a minimum infrastructure, such as to attract private industry. On the other hand, the creation of this infrastructure is very expensive and its creation is uneconomic unless it is utilized by a substantial margin. This creates a vicious circle whereby infrastructure cannot be justified because of lack of industrial superstructure and the latter cannot be created because the former is absent. The conception of the Thessaloniki petrochemical plants as a number of highly inter-related units, created at the same time and in a single location, provided the opportunity for a number of facilities to be established, which will not only supply this hydrocarbon complex, but will make the operation of further new industries in Thessaloniki feasible.

The most significant developments in Greece in this respect were:

i. the creation of a new water supply source, which had been planned but not implemented,

ii. the accelerated construction of a double high tension power line system,

iii. the completion of a new 5th pier at the port of Thessaloniki.

The movement of raw materials and products through the port of Thessaloniki as a result of the creation of this hydrocarbon complex are given in the attached table 11. This movement is

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going to virtually revolutionize the revenues of port operation and will generate income for further improvements which will, in turn, attract more shipping business so that the port can become an autonomous source of growth and activity in the city's economy.

f. <u>Effects on local business activities</u>.

As was implied in the section on employment effects, the operation of the hydrocarbon complex has boosted business activity in the Thessaloniki community. However, rather than generating shortages and inflationary pressures, it has simply raised activity in a balanced way. The reason is simple. It is estimated that about $6.2[8] million were transferred to local property owners for the purchase of land previously in agricultural use, to establish the plants. This capital equity, in turn, was the basis for the creation of real estate to supply new housing needs and the creation or expansion of small businesses supplying services or materials to the hydrocarbon complex and the people working in it. The fact that the hydrocarbon complex has, on the other hand, assured outlets for this new real estate and business, has helped keep the money in the region on a permanent basis. If this money had been transferred to the local population without generating such long term demand it would probably have found its way back into the Athens area or would have been directed to current consumption.

(8) Esso Pappas

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6. Conclusions

Industrial development policy is a tool by which growth that would have taken place much slower, if at all, and in a less efficient and coordinated way can be accelerated and be accomplished without waste for the maximum benefit of the country concerned. In this context the development of the petrochemical industry in Greece is useful in terms of the experience it can add to developmental organization and planning. The preceding paragraphs, I think, demonstrate the following points:

a. An achievement in coordination

The basic petrochemical complex in the country was achieved, with parallel action by the Greek Government, by three major international corporations, namely Standard Oil Company (New Jersey) and Ethyl Corporation from the United States and the Societé St. Gobain from France, the major Greek Bank, the oldest fertilizer company in the country, Mr. T. A. Pappas and other private businessmen. To achieve this in the best of circumstances is a feat in itself; to do it in a developing country verges on the unbelievable. It is interesting to note that the Greek government offered no fianancial assistance, in the implementation of this project, which, in full operation, it is estimated, will generate fiscal revenues of the order of $15 to $20 million per year. The main tools for its implementation were a satisfactory foreign investment law and the bridging of broad government objectives on industrial and regional development

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with specific economic needs that offered sufficient incentive to private business.

b. <u>An achievement in technological integration</u>.

Petrochemical industrial complexes, more or less similar to the Greek one, are not unusual in industrial countries. Nowhere in the world however, has a petrochemical complex of such sophistication been built and started up successfully within a 30-month period. The integration and startup experience of the Greek petrochemical industry is a positive contribution to the technology available world wide.

c. <u>An achievement in regional development</u>.

Many people involved in developmental planning are aware that there has been quite an interest and effort in the last decade devoted to the concept of "industrial poles" in less developed regions in many countries all over the world. There are very few examples, however, of such a pole having been conceived, planned and created within a four-year span without subsidies and an economic government assistance and having transformed the technological productive and socio-economic potential of a whole region.

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Table 1

TOTAL CONSUMPTION OF PETROLEUM PRODUCTS IN GREECE

1956	1,817,000	MT
1961	3,109,000	MT
1962	3,600,000	MT
1963	3,905,000	MT
1964	4,206,000	MT
1965	4,513,000	MT
1966	5,110,000	MT

SOURCE: Esso Pappas

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Table 2

CONSUMPTION OF PLANT NUTRIENTS IN GREECE

'000 MT/YR

Year	N	P_2O_5	K_2O	TOTAL
1956	53,3	38.7	6.1	98.1
1961	78.3	62.6	8.8	149.7
1962	93.1	76.4	10.7	180.2
1963	98.4	82.3	12.0	192.7
1964	125.4	100.3	16.3	242.0
1965	128.8	95.2	14.3	238.3
1966	140.0	105.0	15.0	260.0
1070 - 1975 Forecast Levels	200.0	180.0	30.0	410.0

SOURCE: Ministry of Agriculture - Agricultural Bank of Greece

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Table 3

PLASTICS CONSUMPTION IN GREECE[a]

(MT/YR)

	1961	1962	1963	1964	1965	1966[b]
Condensation products (phelolics, polyesters, melamine, etc.)	2,200	2,600	3,400	4,200	5,900	7,000
Polymerization products						
Polystyrene	2,600	3,300	4,400	6,600	2,800[c]	2.300[c]
PVC and Polyethylene	5,200	7,100	10,400	13,600	16,800	22,400
Others	3,000	4,000	4,800	4,500	5,300	6,700
Cellulose Derivatives	900	1,200	2,000	1,700	1,600	1,700
Total	13.900	18.200	25.000	30,600	32.400	40,100

1970 Forecast[b]

PVC	15,000
Polyethylene	15,000
Polystyrene	12,000
Other plastics	17,000
Total	59,000

(a) National Statistical Service of Greece - External Trade Statistics
(b) Provisional Figures (Jan. - Oct. Actuals)
(c) Incomplete Data
(d) L. H. Manderstam Report (1955)

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Table 4

TOTAL CONSUMPTION AND IMPORTS OF TEXTILES IN GREECE
SYNTHETIC FIBRES CONSUMPTION
(MT/YR)

Item	1961	1962	1963	1964	1965	1966
- Total consumption of textiles[a] (Estimated - Jute excluded)	54,000	57,000	61,000	N.A.	N.A.	N.A.
- Total imports of textiles and textile articles[b]	36,800	39,300	47,300	50.234	62,694	65,000
- Total imports of Synthetic Fibres[b]	727	979	1,820	2,159	2,039	2,479
- Total domestic production of synthetic fibres[a]			300	N.A.	N.A.	N.A.
- Synthetic Fibres consumption pattern by type of product (estimated)[a]						
-Nylong (6 + 66)	-	-	60%	-	-	-
-Acrylic	-	-	30%	-	-	-
-Polyester	-	-	10%	-	-	-

(a) L. H. Manderstam Report
(b) National statistical service of Greece -External Trade Statistics
(c) Provisional Figures (Jan. - Oct. Actuals)

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Table 5

CRUDE RUBBER AND RUBBER ARTICLES CONSUMPTION IN GREECE[a]
(COMBINED NATURAL AND SYNTHETIC)
('000 T/YR)

	1961	1962	1963	1964	1965	1966[b]
Crude Rubber	5.1	6.0	7.4	6.4	6.7	6.8
Misc. Rubber Articles (incl. tyres)	5.8	5.8	5.8	6.0	6.7	6.6
Rubber fabricated materials	0.9	0.9	1.1	1.0	1.0	1.2
Total	11.8	12.7	14.3	13.4	14.4	14.6
Styrene Butadiene Rubber (SBR)[c] (estimated)	3.4	4.2	4.8	4.9	5.3	5.4

1970 Forecasts[c]

	Minimum	Maximum
Total Rubber	13.5	19.0
Synthetic Rubber (SBR) type	8.0	12.0
	6.0	9.0

(a) National Statistical Service of Greece - External Trade Statistics
(b) Provisional Figures (Jan. - Oct. Actuals)
(c) L. H. Manderstam Report (1965)

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Table 6

THESSALONIKI PETROCHEMICAL COMPLEX
TECHNICAL AND ECONOMIC CHARACTERISTICS

PLANT	PRODUCT	DESIGN CAPACITY (MT/YR)	FIXED INVESTMENT ($ MILLION)	EMPLOYMENT (1967)
	ESSO PAPPAS GROUP			
Refinery -	Petroleum Products	2.500.000	22.3	296
Ammonia -	Ammonia	105,000	8.2	72
Steam Cracker-	Ethylene	15,000		
Solvents	Hexane White Spirits Others	24,000	6.4	66
Other Petro-chemicals	PVC Caustic Soda Chlorine Sod. Hypochlorite, Muriatic Acid, etc.	12,000 30,000 27,000 23,000	16.1	197
Esso Pappas Indistrial Co.	Power Steam Water Misc. Facilities	100 MW 100 MT/HR 1000 M^3/HR	18.8	(Allocated to plants above)
	Sub-Total		71.8	631
	ETHYL HELLAS			
Ethyl	Tetraethyl Lead Tetramethyl Lead Ethyl Chloride Methyl Chloride	25,000	15.0	200
Ethylene Chlo.	Ethylene Chloride Vinyl Chloride			
	SICNG			
Fertilizers	Fert. Compounds (16-20-0)	200,000	11.0	250
	Grand Total		97.8	1,081

SOURCE: Esso Pappas, Ethyl Hellas, SICNG

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Table 7

THESSALONIKI REFINERY AND PETROCHEMICAL COMPLEX
INTRACOMPLEX MOVEMENTS AND RELATED DESIGN
CAPACITIES

(MT/YR)

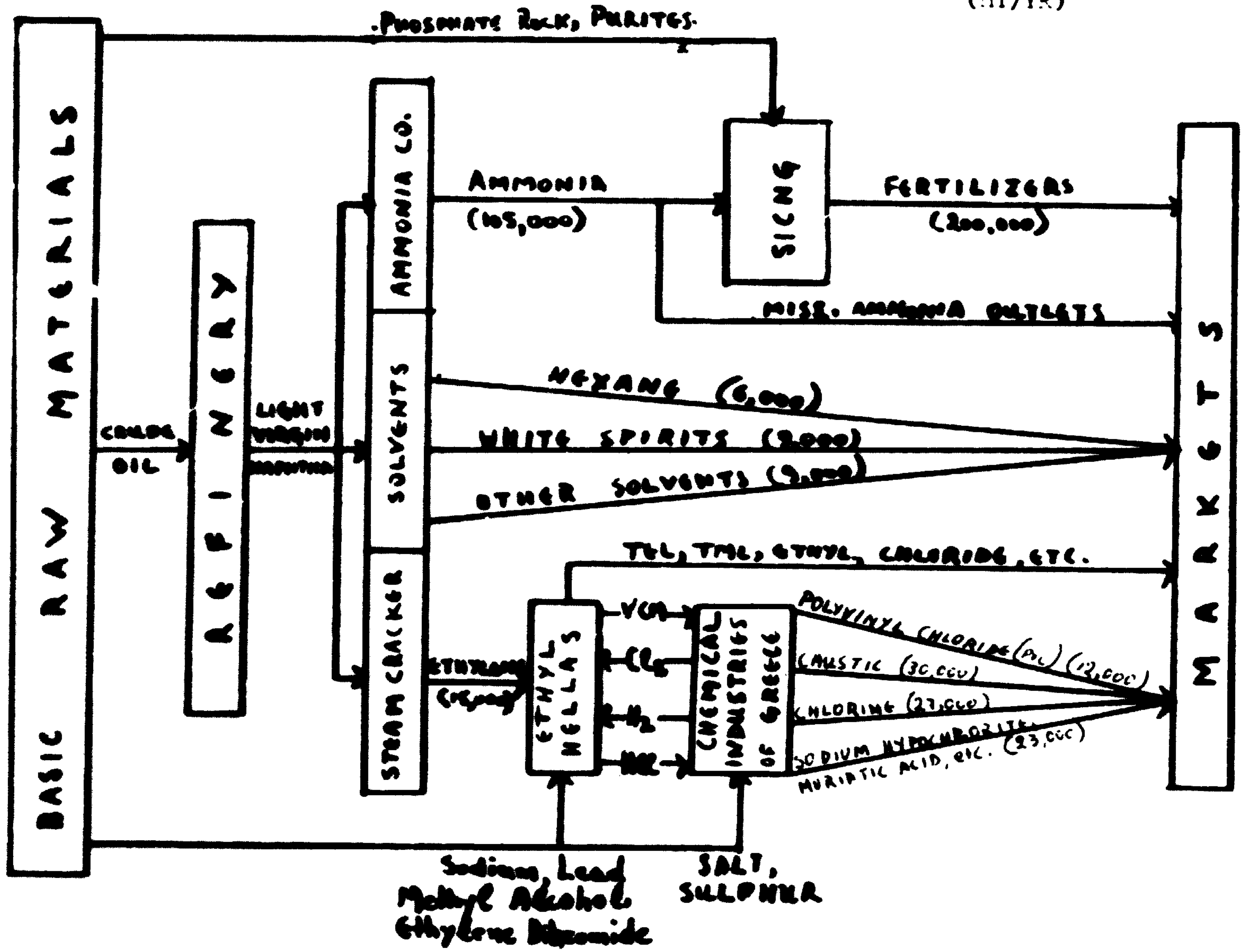

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Table 8

EFFECT OF THE THESSALONIKI PETROCHEMICAL COMPLEX ON STRUCTURE OF INVESTMENT IN GREECE

	$ in current prices
- 1962 - 1964 Average Annual Fixed Asset Formation-Total Greece	880,266,000[(a)]
- 1962 - 1964 Average Annual Fixed Asset Formation-Manufacturing	107,411,000[(a)]
- 1965 Manufacturing Industry Total Assets	1.500,000,000[(b)]
- 1965 50 Largest Industries Total Assets	690,009,000[(c)]
- 1960 - 1966 Total imported Capital into Greece under Foreign Investment Law 2687	348,400,000[(d)]
- Thessaloniki Petrochemical Complex Fixed Investment	97,800,000[(e)]

(a) National Accounts of Greece (1958 - 1964)
(b) Center of Planning and Economic Research (Draft of five-year Plan 1966-1970)
(c) ICAP Financial Directory of Greek companies - 1966
(d) Ministry of Coordination
(e) Esso Pappas

Table 9

EFFECTS OF THE THESSALONIKI PETROCHEMICAL COMPLEX ON INDUSTRIAL PRODUCTION

PRODUCTION INDEX[a]	1964	1965	1966	1965/1964 %	1966/1965 %
Manufacturing General	146.6	158.4	182.8	8.0	15.5
Chemicals	168.2	181.4	216.7	7.8	19.5
Coal and Petroleum	119.7	121.1	175.0	1.2	44.5

(a) National Statistical Service of Greece

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Table 10

EFFECT OF THE THESSALONIKI PETROCHEMICAL COMPLEX ON THE GREEK BALANCE OF PAYMENTS

1966 TOTAL EXPORTS OF GREECE	1966 MANUFACTURING EXPORTS	1967 THESS.PETR.COM. EXPORT FORECAST	1967 THESS.PETR.COM. IMPORT SAVING FORECAST	% (3÷1)	% (3÷2)
1	2	3	4	5	6
$403,487,000[a]	$49,510,000[a]	$18,182,200[b]	$20,054,000[b]	4.5	36.8

(a) Bank of Greece
(b) Esso Pappas

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Table 11

EFFECT OF THE THESSALONIKI PETROCHEMICAL COMPLEX ON THESSALONIKI PORT MOVEMENTS

PORT MOVEMENTS IN MT LOADED AND DISCHARCHED

1965	1966	ATTRIBUTABLE TO THESSALONIKI PETR. COMPLEX DURING 1966	1970 FORECAST OF THE THESS.PETR. COMPLEX MOVEMENTS
2,153,626 (a)	4,515,836 (a)	2,177,879 (b)	4,500,000 (b)

(a) Thessaloniki Port Authority
(b) Esso Pappas

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