OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

1985

14961

SYRIAN DOWN STREAM PETROCHEMICAL AND REFINING INDUSTRIES.

Working paper

Prepared by

J.M. Wakim

Wakim Associates

Burington, Ontario, Canada

SYRIAN PETROCHEMICAL DEMAND

The mission conducted to Syria in late February 1985 confirmed that there is no domestic production for the basic petrochemicals in the country. Therefore, to estimate the domestic demand for these products, we surveyed the Syrian imports of about 75 products.

Syrian import statistics were aggregated in such a way that it was impossible to determine the quantities or values of individual products. Therefore, to determine the imports of individual products we had to rely on alternate methods. The method we chose was to survey the exports, of each of these products, from the producing countries to Syria.

Syria imported small quantities of all of these products. A listing of the major petrochemical imports is shown in Chart 1. It covers the imports of 15 products from 1976 to 1983. The products can be classified into ethylene derivatives (polyethylene, PVC, and ethylene glycol), propylene derivatives (polypropylene, Isopropyl alcohol, and acetone), and aromatics and their derivatives (toluene, xylene, polystyorene, SBR, and epoxy resins).

In the absence of domestic production, imports represent the domestic demand. The demand of all of these products is too small to justify domestic production. All of these products are traded globally from world scale plants which enjoy cost advantages derived from economies of scale. Any new plants must be world scale to be economically viable. And those plants built to serve small domestic markets must have access to, and be competitive in export markets. In addition, these plants are not built on a stand alone basis; rather they are incorporated in large complexes which rely on the synergies which exist between derivative plants of a single building block such as ethylene or propylene.

Libya, Qatar and Saudi Arabila are among the Arab countries which have built large integrated petrochemical complexes. However, the most impresive of these complexes are in Saudi Arabia.

Chart 1

Syrian imports of selected petrochemicals

(Kt)

Product	1983	1982	1981	1980	1979	1978	1977	1976
polyethylene	4.10	4.81	13.56	13.33	18.49	10.98	1.93	0.14
pvc	10.10	9.34	7.25	7.94	6.68	5.01	2.35	1.58
polypropylene	4.02	4.79	5.85	5.31	9.08	5.23	0.30	0.04
polystyrene	3.38	4.00	4.46	3.82	0.49	1.03	1.00	0.61
polyesters	0.56	1.09	1.06	1.62	1.04	0.93	0.00	0.74
sbr	3.48	3.56	3.53	3.35	1.43	0.98	0.26	0.07
epoxy resins	0.06	0.03	0.08	0.17	0.73	0.06	0.01	0.00
toluene	0.39	0.26	0.05	0.12	0.19	0.07	0.82	0.00
xylene	1.02	3.83	1.07	1.06	2.15	4.02	0.00	0.00
ethylene glycol	0.01	0.01	0.11	0.05	0.00	0.07	0.21	0.00
isopropyl alcoho	0.12	0.13	0.08	0.04	0.44	0.21	0.00	0.00
acetone	0.03	0.09	0.13	0.14	0.57	0.52	0.03	0.00
methanol	0.05	0.05	0.03	0.05	0.16	0.04	0.00	0.00
sodium hydroxide	3.96	17.13	5.75	3.79	4.89	3.60	3.40	0.07
chlorine	0.10	0.10	0.33	0.92	2.21	0.58	0.00	0.00

THE SAUDI ARABIAN PETROCHEMICAL INDUSTRY

Saudi Arabia adopted an industrialization policy aimed at upgrading the natural resources of the Kingdom and increasing the value added in products shipped to the export markets. In compliance with this policy, the Saudi's have built, or are in the process of building plants which will produce around 40 petrochemicals. Chart 2 lists the products, the location, plant capacity (CAPACI), the company, the partners, the technology, the capital costs in millions of US dollar (CAPITA), the year of startup (STARTU), and the feedstock used.

We have included, in Chart 2, the partners in each of the plants which will produce significant quantities for export. Also included in the chart is the technology used because of its impact on the competitiveness of the products in world markets. The capital is included as an indication of the financial commitment necessary to produce each product. The startup year is mentioned to indicate the present status of the projects. The feedstock is listed to indicate the degree of downward integration of the plants.

Chart 3 aggregates the ethylene and derivative plants by product. The downstream integration of petrochemical facilities is essential for exploiting the synergies of interdependent derivatives plants. The three Saudi ethylene crackers can be used as typical sound downstream integration.

THE PETROYMYA ETHYLENE AND DERIVATIVES COMPLEX IN AL JUBAIL (Chart 4)

Products and markets:

Ethane is fed to the cracker to produce the ethylene building block. The ethylene is used in three derivatives plants:

- Ethylene oxide. part of the ethylene oxide can be exported and the other is hydrated to produce ethylene glycol; most of the ethylene glycol is for the export market.

- Polyethylene. The plant is flexible in that it can be used to produce linear low density polyethylene (LLDPE) or high density

Chart 2

Saudi Petrochemical plants

Page 1

product	location	capaci	company	partners	technology	capita	startu	feedstock
acetic acid	al jubail	80	sabic				1987	methanol
alkyd resin	jeddah	2.0	sir				1982	
ammonia	al jubail	330	sabic	taiwan fertiliz		357	1984	natural g
ammonia	al jubail	500	safco	sabic	kellog	100	1988	natural g
ammonia	dammam	200	safco				11970	natural g
benzene	al jubail	327	sabic	shell	shell		1985	
butadiene	al jubail	124	sabic	agip/neste oy	basf		1980	butane
butadiene rubber	yanbu	100	nic	michelin	michelin	300	p	butadiene
butene 1	al jubail	80	sabic	agip/neste oy	basf		1988	butane
calcium carbide	riyadh	23	prince bandar		hoecesht	15	1984	
carbon active	taif	2	degremont		krebs		1985	
chlorine	al jubail	377	sadaf	shell usa	diamond sh		1985	salt
chlorine	dammam	7	sabic		denora	5	1984	salt
detergent synthetic		50	nic				p	
edc ethylene dichlor	al jubail	454	sadaf	shell usa			1985	ethylene
eg ethylene glycol	al jubail	300	sharq sabic	mitsubishi		800	1985	ethylene
eg ethylene glycol	yanbu	220	yanpet sabic	mobil	halcon sd	25	1986	ethylene
eo ethylene oxide	al jubail	300	sharq				1985	ethylene
eo ethylene oxide	yanbu	220	yanpet	mobil	mobil		1985	ethylene
ethanol	al jubail	281	sadaf	shell usa	shell		1985	ethylene
ethylene	al jubail	500	petrokemya sabic	100% sabic	carbide	1500	1985	ethane
ethylene	al jubail	656	sadaf	shell usa	shell	900	1985	ethane
ethylene	yanbu	455	yanpet sabic	mobil	mobil	2100	1985	ethane
hdpe	yanbu	91	yanpet sabic	mobil			1985	ethylene
hydrocarbon solvents	al jubail	12	khalifa algosaibi		mauzen engineer	[illegible]	1985	naphtha
lldpe	al jubail	270	kemya sabic	exxon	carbide	1500	1985	ethylene
lldpe	al jubail	130	sharq sabic	mitsubishi	carbide	800	1985	ethylene
lldpe	yanbu	205	yanpet sabic	mobil	carbide		1985	ethylene
melamine	dammam	20	safco		stamicarbo	30	1985	
methanol	al jubail	700	national methanol	[illegible]	ici	400	1984	natural g
methanol	al jubail	600	saudi methanol	mitsubishi +	ici	405	1984	methane
mtbe	al jubail	500	sabic	[illegible]	snamprogget	452	1988	
naoh	al jubail	377	sadaf	[illegible]	diamond sh		1985	salt
naoh	dammam	[illegible]	sabic		denora	5	1984	salt
pet							p	
pharmaceuticals	qasim		nic			100	p	
phenolic resin	jeddah	21.0	sir				1982	
polyol		3	latif s albatein		upjohn synthesi		p	
polyurethane		4	latif s albatein		upjohn synthesi			
[illegible]	dammam	[illegible]	ici		ici	7	1984	
[illegible]		4	[illegible]				[illegible]	
[illegible]	[illegible]	[illegible]	sabic				[illegible]	
polyvinyl acetate	al jubail	60	sabic				p	
[illegible]	al jubail	70	sabic				[illegible]	styrene
[illegible]	[illegible]	150	arabian chem co	[illegible]	[illegible]	30	[illegible]	styrene
[illegible]		[illegible]	[illegible]				[illegible]	
[illegible]	al jubail	200	sabic	[illegible]	[illegible]		[illegible]	vcm
styrene	al jubail	295	sadaf	[illegible]			1985	[illegible]
sulfur	al jubail	150	petromin	shell			[illegible]	
sulfur	dammam	15	said ali ghordan		[illegible]	[illegible]	[illegible]	

Saudi Petrochemical Plants

product	location	capaci	company	partners	technology	capita	startu	feedstock
sulfur	eastern provinc	1000	aramco		wimpey	100	1984	
suifur	ras tanura	100	aramco			8.5	1986	
sulfuric acid	dammam	100	safco				1970	sulfur
titanium dioxide	al jubail	50	idi		chloride-route	140	p	rutile
urea	al jubail	500	samad sabic	taiwan fertiliz		357	1984	methane
urea	dammam	330	safco				1970	ammonia
vcm vinyl chloride	al jubail	300	sabic	lucky	goodrich b f		1986	ethylene

Chart 3

Ethylene plants in Saudi Arabia

01-01-1980 Page 1

location	capaci	company	partners	technology	capita	startu	feedstock
al jubail	500	petrokemya sabic	100% sabic	carbide	1500	1985	ethane
al jubail	656	sadaf	shell usa	shell	900	1985	ethane
yanbu	455	yanpet sabic	mobil	mobil	2100	1985	ethane

TOTAL

capacitykt	1,611.00
capitalm$	4,500.00

Printed 3 of the 457 records.

Ethylene Oxide Plants in Saudi Arabia

01-01-1980 Page 1

location	capaci	company	partners	technology	capita	startu	feedstock
al jubail	[illegible]	sharq				1985	ethylene
yanbu	220	yanpet	mobil	mobil		1985	ethylene

TOTAL

capacitykt	520.00
capitalm$	0.00

Printed 2 of the 457 records.

Ethylene Glycol Plants in Saudi Arabia

[illegible] Page 1

location	capaci	company	partners	technology	capita	startu	feedstock
[illegible]	[illegible]	[illegible] sabic	mitsubishi		800	1985	ethylene
[illegible]	[illegible]	[illegible]	mobil	[illegible]	25	1985	ethylene

TOTAL

capacitykt	[illegible]
capitalm$	[illegible]

Printed 2 of the 457 records.

Polyethylene Plants in Saudi Arabia

01-01-1980 Page 1

product	location	capaci	company	partners	technology	capita	startu	feedstock
hdpe	yanbu	91	yanpet sabic	mobil			1985	ethylene
lldpe	al jubail	270	kemya sabic	essc	carbide	1500	1985	ethylene
lldpe	al jubail	130	sharq sabic	mitsubishi	carbide	800	1985	ethylene
lldpe	yanbu	205	yanpet sabic	mobil	carbide		1985	ethylene

	TOTAL
capacitykt	696.00
capitalm$	2,300.00

Printed 4 of the 457 records.

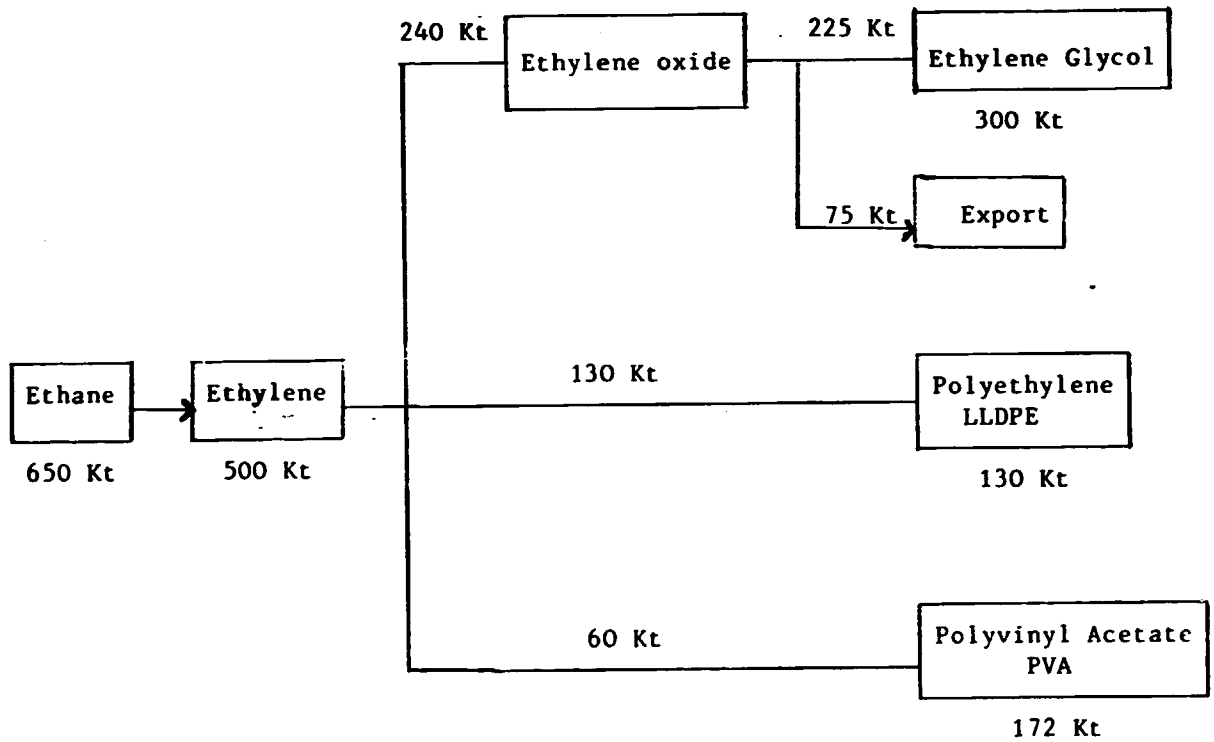
PVC and Related Plants in Saudi Arabia

01-01-1980 Page 1

product	location	capaci	company	partners	technology	capita	startu	feedstock
edc ethylene dichlor	al jubail	454	sadaf	shell usa			1985	ethylene
pvc polyvinyl chlori	al jubail	200	sabic	lucky	goodrich b f		1986	vcm
vcm vinyl chloride	al jubail	300	sabic	lucky	goodrich b f		1986	ethylene

Chart 4

Petrokymya ethylene and derivatives complex in Al Jubail



polyethylene (HDPE). Most of the polyethylene produced is destined for export to other Arab or international markets.

- Polyvinyl Acetate (PVA). Most of the PVA is destined for export markets.

Volumes

All of the plants included in this complex are world scale. 650,000 metric tons (Kt) of ethane are needed to produce 500 Kt per year of ethylene.

- The ethylene oxide plant consumes about 240 Kt ethylene to produce 300 Kt of ethylene oxide.

  75 Kt of ethylene oxide are destined for the export markets and 225 Kt are upgraded locally to produce 300 Kt of ethylene glycol.

- The polyethylene plant consumes about 130 Kt ethylene to produce 130 Kt of linear low density polyethylene or high density polyethylene.

- The polyvinyl acetate plant consumes about 60 Kt of ethylene.

the derivative plants consume about 430 Kt of ethylene creating a base load of about 86 per cent to the ethylene crackers. Productivity improvements leeding to increased output from all of these plants are expected. The plants can be debottlenecked to supply the increased demand.

Marketing

The petrokymya plant is wholly owned by Sabic. However, it will be operated by union carbide for an operating and management fee. The total ethylene production will be bought by the these derivative plants.

As discussed earlier, having access to international markets is essential for the viability of world scale plants built in small domestic markets. Sabic are promoting their products in export markets very efficiently. However, for a new producer, time is needed to gain market share. Sabic has decided that to reduce the time needed to sell the output of these plants, they need to form joint ventures with corporations having global marketing networks. These joint venture partners are expected to market whatever Sabic can not sell. As Sabic gains experience and market share, the joint venture partners will have reduced quantities from the Saudi pants.

- Ethylene oxide/glycol plants. Mitsubishi is the joint venture in these plants known as 'SHARQ'. They will market their share mostly in Japan and the far east.

- Polyethylene. Mitsubishi is the joint venture parnter in the polyethylene plant. They are expected to market their share of the plant output in Japan and the far east.

- Polyvinyl Acetate. This plant is expected to come on stream in 1987. Sabic has not announced their marketing strategy for the output from this plant.

THE SADAF ETHYLENE AND DERIVATIVE PLANT IN AL JUBAIL (Chart 5)

Products and markets:

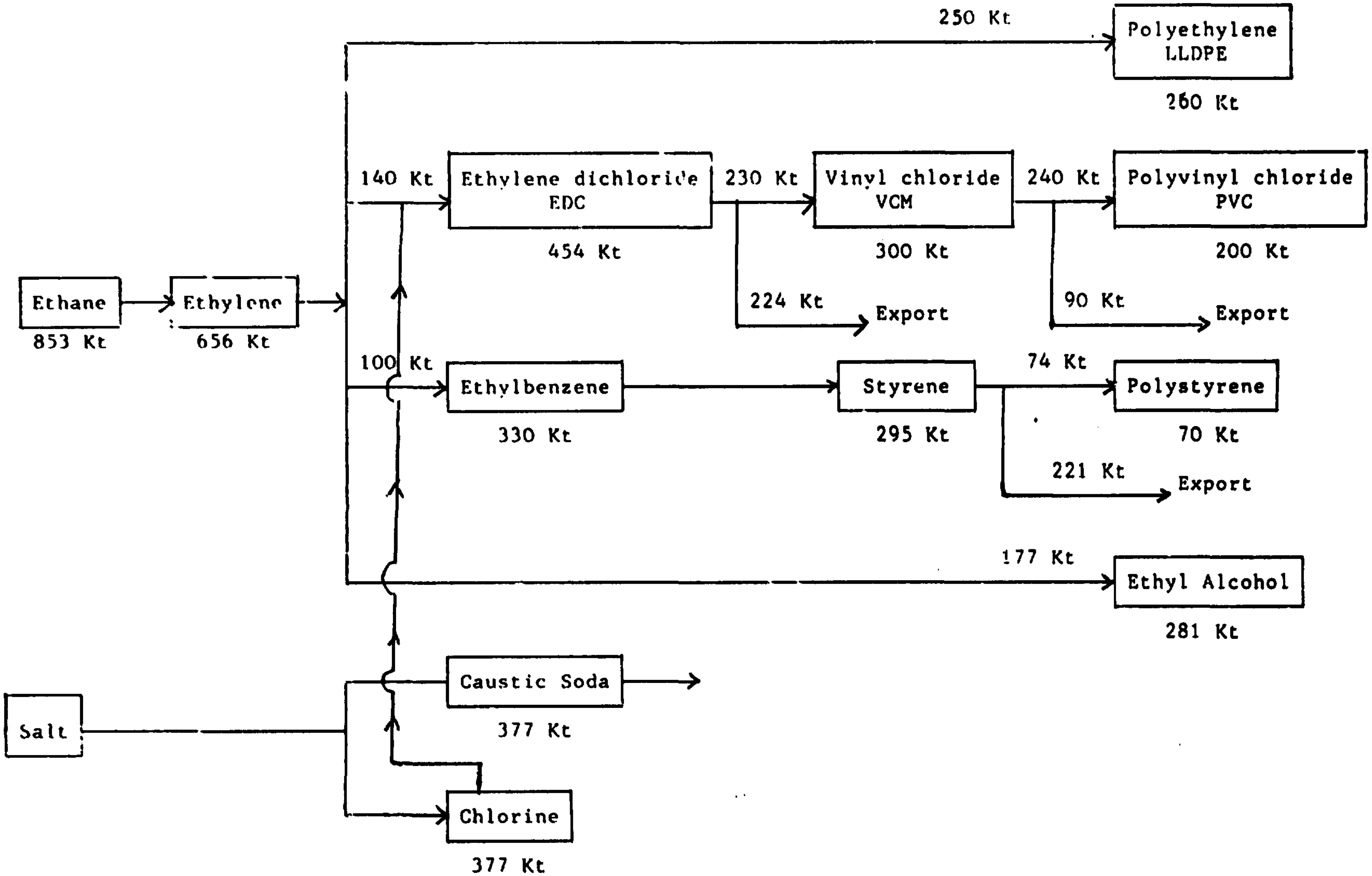
SADAF is the largest and most diversified Saudi petrochemical complex. It uses ethane to prodce ethylene, and salt to produce chlorine and caustic soda. The ethylene is used to produce the following derivatives:

- Polyethylene. Most of the polyethylene is destined for export markets.

- Ethylene dichloride. In addition to ethylene Sadaf produces chlorine which is reacted with ethylene to produce ethylene dichloride (EDC). Part of the EDC will be exported to international markets. Another part will be upgraded further to vinylchloride (VCM). Some VCM will be exported. However, more than 60 per cent of the VCM produced will be upgraded further to polyvinylchloride (PVC). The Saudi market consumes a significant volume of PVC. The balance will be sold in other Arab countries and internatioanl markets.

Chart 5

SADAF ethylene and derivatives complex in Al Jubail



- Ethylbenzene. Ethylene from sadaf is reacted with benzene from the petromin refinery (across the fence) to produce ethylbenzene. The ethylbenzene is upgraded to styrene. Part of the styrne is exported. The balance is upgraded to polystyrne (PS). A significant part of the polystyrene will be consumed in the markets of Saudi Arabia and other Arab markets.

- Ethyl alcohol. Ethylene is hydrated to produce commercial ethyl alcohol, which will be totally exported for further processing in the US market.

- Caustic soda. Caustic soda will be produced from the electrolysis of brine. Part of the caustic soda will be used for Aluminium smelting in Saudi Arabia and part will be exported to international markets.

- Chlorine. Chlorine is a co-product from the electrolysis of brine. Most of the chlorine will be consumed in the manufacture of EDC.

Volumes

The production of about 650 Kt of ethylene in the Sadaf complex requires about 850 Kt ethane. The ethylene balance is expected to be as follows:

- Polyethylene. About 250 Kt per year of ethylene are needed to produce polyethylene.

- Ethylene dichloride. The EDC plant will consume about 140 Kt ethylene to produce 454 Kt EDC. About 220 Kt of EDC will be exported and 230 Kt will be upgraded to produce VCM. About 90 Kt of VCM will be exported and 210 Kt will be upgraded to PVC. The PVC will be sold in the markets of Saudi Arabia and other Arab countries.

- Ethylbenzene. About 100 Kt of ethylene will be consumed to manufacture 330 Kt of ethylbenzene. The ethylbenzene will be upgrade to styrene. About 220 Kt of styrene will be exported to global markets. The remaining 74 Kt will be upgraded to polystyrene which will be marketed in Saudi Arabia and other Arab countries.

- Ethyl alcohol. About 177 Kt of ethylene will be consumed in the manufacture of ethyl alcohol which will be exported mostly to the US markets.

Marketing

The Saudi marketing plan for the petrochemicals produed by Sadaf is similer to that used at petrokymya. The joint venture partners were selected to optimize Sabic's ability to market the products.

- Shell was selected as the joint venture partner in the cracker, the EDC plant, the ethylbenzene/styrene plant, the ethyl alcohol plant, and the chlor alkali plant.

- Exxon was selected as the joint venture partner in the polyethylene plant.

- Lucky of South Korea was selected as the joint venture partner for the VCM and PVC plants.

- Sabic has not announced their marketing plans for the polystyrene plant.

Cracker utilization:

Te Sadaf complex is fully integrated. The derivatives plants can consume 667 Kt ethylene when operating at name plate capacity. This is equivalent to about 102 per cent of the name plate capacity of the cracker. Therefore, the derivative plants can operate at less than name plate capacity or purchase ethylene from the petrokymya cracker. Alternatively, Sadaf can increase their cracker capacity to satisfy the needs of the associated derivatives plants.

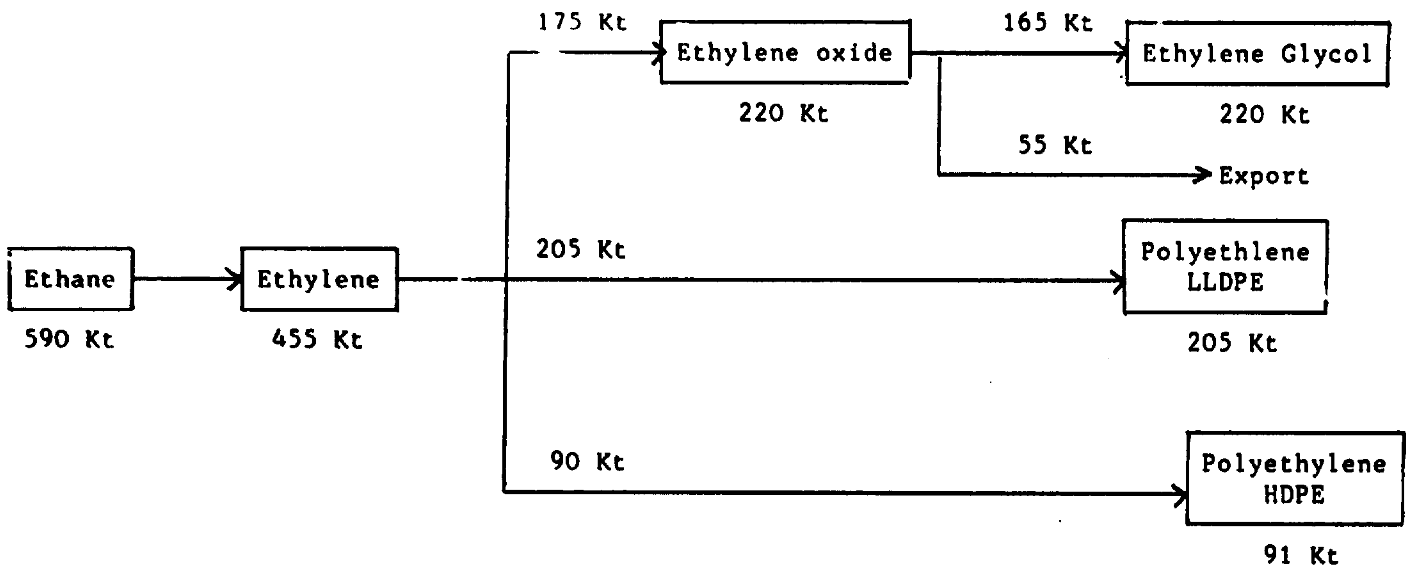
THE YANPET ETHYLENE AND DERIVATIVES COMPLEX IN YANBU (Chart 6).

Products and markets;

The Yankpet complex in Yanbu, on the red sea, also uses ethane to produce ethylene. The ethylene is used to produce the following products.

Chart 6

Yanpet Ethylene and derivatives complex in Yanbu



- Ethylene oxide. Most of the ethylene oxide is hydrated to produce ethylene glycol. The balance is exported. Most of the ethylene glycol is exported to international markets.

- Polyethylene. Ethylene is upgraded to linear low density polethylene (LLDPE). Most of the LLDPE produced at Yankpet is destined for the export markets.

- High density polyethylene (HDPE) will also be produced at Yanpet. Most of the production will be exported.

Volumes

The production of 455 Kt ethylene will consume about 590 Kt of ethane. The ethylene will be used to produce the following derivatives:

- Ethylene oxide. About 175 Kt ethylene will be consumed to produce ethylene oxide. About 44 Kt of the ethylene oxide will be exported. The remaining 165 Kt produce annually will be upgraded to produce 220 Kt of ethylene glycol. Most of the ethylene glycol will be exported.

- Linear low density polyethylene (LLDPE). About 205 Kt ethylene will be consumed to produce LLDPE. Most of the LLDPE will be exported to international markets.

- High density polyethylene (HDPE). About 90 Kt ethylene will be consumed annually to produce 91 Kt of HDPE. Most of the HDPE will be exported to international markets.

Marketing:

The Saudi marketing plan for the petrochemicals produced at Yanpet is similar to that followed in the other two crackers. Mobil is the joint venture partner in the cracker, the ethylene oxide/ethylene glycol plant, the HDPE plant, and the LLDPE plant.

Cracker utilization:

The Yanpet cracker is fully integrated with the derivatives plants. When these plants are operating at name plate capacity they consume about 470 Kt ethylene. This is equivalent to about 103 per cent of the cracker name plate capacity.

PETROCHEMICAL PLANTS IN OTHER ARAB COUNTRIES

Other Arab countries developed different industrialization policies. Three other countries are mentioned in this report for illustration:

The Iraqi petrochemical plants

Iraq has large reserves of crude oil and natural gas as well as a significant refining industry. The reserves can guarantee the long-term availability of feedstocks for a petrochemical industry. The refining segment indicate that the infrastructure for building a petrochemical industry is available. Furthermore, the Iraqi population is relectively large. Therefore, the domestic market for petrochemicals can support some manufacturing facilities to satisfy the total demand (replace imports) and to export the surplus production.

Chart 7 is a listing of the Iraqi petrochemical plants. There is presently no ethylene or ethylene derivative production in the country. And, as far as we know, there are no plans to build any crackers in Iraq over the coming 5-10 years. Most of the plants listed in Chart 7 were built to primarily satisfy the domestic market.

THE EGYPTIAN PETROCHEMICAL PLANTS (Chart 8).

In recent years, Egypt has become a net exporter of crude oil. The proven reserves of crude oil and natural gas are large enough to guarantee a secture supply of feedstocks for the refining and petrochemical industries. The Egyptian Government has indicated its interest in broadening the industrial base in the country. Therefore, it is expected that increased volumes of crude oil will be upgraded to higher value added products for use domestically or for export.

The broadening of the industrial base will create new industries and increase the size of existing ones. This will generate new jobs, which are needed to satisfy the increasing Egyptian population.

Chart 7

Iraqi petrochemical plants

06-03-1985 Page 1

product	location	company	capaci	capita	startu
alkyl benzene linear	baiji	arab co deter	50	100	
aluminum fluoride	alkaim	som	11	38	1984
ammonia	baiji	state	1000	275	1988
antibiotics	baghdad	arab co drugs		300	1985
benzene	baiji	arade*	30		1986
furfural	baiji	scop			1984
furfural	basrah	scop			1984
hdpe	basrah	state	30		1990
methanol	ras al khaima	state	825	350	1985
pvc polyvinyl chlori	basra	state	60		1990
sulfur		state	153		
sulfur	baiji	state	92		1984
sulfuric acid	al kaim	state	50		1984
sulfuric acid	al kaim	state	1500		p
urea	baiji	state	1700	275	1988

Chart 8

Egyptian petrochemical plants

06-03-1985

Page 1

product	location	company	capaci	capita	startu
alkyl benzene linear		nasr petroleum	40		1984
aluminum sulfate		boliden			1986
btx	alexandria	nasr petroleum	550		1985
chlorine		epc	60	50	1985
chlorine	alexandria	rakta	3		1985
detergent synthetic		alexoil	39		1986
detergent synthetic		egypt ind	39		1986
naoh		epc	60	50	1985
naoh	alexandria	rakta	3		1985
polyester fiber	kafr el dawar	misr rayon	3.3		1986
pvc polyvinyl chlori	alexandria	epetco	80	92	1985
soda ash	el mex	misr chemical ind	200	80	
sodium hypochlorite	suez	egyptian electric	1.1		1987
sulfonic acid		alexoil	11		p
sulfonic acid		egypt ind	7.8		1986
sulfuric acid	abu zaabal	abu zaabal fertil	218		1984
vcm vinyl chloride	alexandria	epetco	100	32	1985

With a population of around 45 million people. Egypt is the largest population centre in the Arab world, and could become the largest market for petrochemicals. Similar populations in developed countries create a market large enough to load several world scale petrochemical plants.

Presently there are no plans to build ethylene crackers in the coming 5-10 years in Egypt. Therefore, the domestic market will be satisfied by imports, most probably from other Arab countries, notably Saudi Arabia.

THE LIBYAN PETROCHEMICAL PLANTS (Chart 9).

Libya has a relatively small population of around 4 million. It has a small domestic marekt for petrochemicals which is not sufficient to load world scale petrochemical plants.

However, Libya has sizeable reserves of crude oil and natural gas which are essential for building a viable petrochemical industry. Based on these reserves the Libyan Government has embarked on an industrialization policy which has lead to the buildup of petrochemical production capacities aimed mainly at the export markets.

Chart 9 shows most of the existing and planned Libyan petrochemical facilities. They include a world scale ethylene cracker with associated derviative plants. They also include a 660 Kt methanol plant, a polypropylene plant, and butylenes plant. Plans to build MTBE, butadiene, and styrene plants are at various levels of implementation. By 1990, Libya will be, next to Saudi Arabia, a major supplier of petrochemicals to the Arab world and international markets.

Chart 9

Libyan petrochemical plants

06-03-1985 Page 1

product	location	company	capaci	capita	startu
butadiene		rasco	60		1989
butylenes	ras lanouf	rasco	130		1985
detergent synthetic	ain temouchent	soc national in	90	60	1986
detergent synthetic	chelgoumelaid	soc national in	90	60	1986
detergent synthetic	sour elghoslane	soc national in	90	60	1986
eg ethylene glycol	ras lanuf	rasco	58		1988
ethylene	ras lanouf	rasco	330		1985
hdpe	ras lanouf	linoco	80		1988
lldpe	ras lanouf	rasco	80		1988
methanol	marsa el brega	napetco	660		1984
mtbe	ras lanouf	rasco	60		1990
pp polypropylene	ras lanouf	rasco	68		1984
propylene		rasco	170		1985
sodium hypochlorite	tuzla	hyundai	4.3		
styerene	ras lanuf	national oil corp	175		1988
sulfuric acid	sirte	state	165		p

SYRIAN PETROCHEMICAL OPTIONS

Syria has the crude oil and natural gas reserves necessary to supply feedstocks for a world scale petrochemical industry. However, the domestic market is too small to consume an acceptable base load from the output of these plants. Therefore most of the production must be exported.

Petrochemicals are traded as global commodities. The prices, in the international markets, are set by the most efficient manufacturing plants. Producers must be competitive in this market environment to be considered as viable suppliers. The cost of feedstocks accounts for about 70 per cnet of the selling price of most petrochemical building blocks. Therefore,, to maintain a presence in the market, the producer must have either a technological edge or low cost feedstocks.

A technologicl edge is not very likely in commodities. The global trade flow of petrochemical products is no more prevalent than the flow of petrochemical technology. The owners of these technologies are competing fiercely to license their know-how to other producers. As a matter of fact, several multinational companies have followed a strategy of maximizing cash generation by licensing their technology rather than by producing and marketing petrochemical commodities. Another illustration of technology migration is the number of companies using technologies developed by others. A quick survey of such companies shows that the number of producers using third party technology has been increasing over the years.

Low cost feedstocks have been used as an incentive for the development of the petrochemical industry in many parts of the world. A petrochemical industry mushroomed on the US Gulf coast because feedstocks (natural gas liquids) were made available at very low prices in the early parts of this century. The Canadians build-up of world scale petrochemical plants in Alberta in the mid-70s was based on natural gas controlled at very low prices compared to crude oil. The mexicans assign a very low price to natural gas to encourage the building of chemical plants to satisfy the domestic market and export the surplus production. The Saudis are in the final stages of building a large petrochemical industry which is based on low price ethane and natural gas.

Syria has the power to assign low values to natural gas, natural gas liquids, and crude derived petrochemical feedstocks to encourage the build-up of a petrochemical industry in the country. However, aside from fertilizers (ammonia, urea, and derivatives) the market is too small to consume the production from world scale plants. Therefore the bulk of the production must be exported. Saudi Arabia and Libya have followed a similar strategy. However, because of the surplus global capacity, of the basic petrochemicals, which exists presently and is expected to continue for the rest of 1980's, we do not recommend the build-up of new capacity.

Thermoplastic processing:

There is another opportunity which Syria can exploit. The domestic market is currently in need of and can consume greater quantities of downstream derivatives of petrochemicals. For example, the Syrian market consumes processed thermoplastics such as polyethylene film, bags and sheets, and PVC sheets, tiles, pipes, and synthetic leather. These products are mostly imported in finished form. The processing plants, which currently exist in Syria, are small, owned by the private sector, and unable to meet the needs of the market. The build-up of large modern processing plants will be able to produce economically enough product to satisfy the market demand and export high value added products. Such plants will generate jobs for Syrians and improve the balance of trade for the country.

The raw materials needed for a Syrian plastics processing industry are polyethylene, PVC and polystyrene resins. These products are available from other Arab countries or from international markets at competitive prices. Long-term contracts for supply of raw materials can be arranged on favourable terms. Furthermore, the cost of capital installations needed to build this industry is relatively small. Based on these facts, we feel that such an approach is appropriate for the Syrian economy.

Fertilizer industry:

The Syrian agricultural market is large enough to consume the output of more than one ammonia/urea world scale complex. Increased use of nitrogen fertilizers will increase the yields of crops collected by farmers and improve Syria's position in essential food production.

The fertilizer complex in Homs is capable of meeting most of the market needs. It is run by a crew of very highly qualified and capable staff. Dr. I. El-Zaim and J.M. Wakim visited the plant in late February 1985 and discussed operations with the staff. The discussion highlited some issues which we have analyzed and report as follows:

A. Profitability of the fertilizer complex

Under the present arrangements, the fertilizer complex is required to sell ammonia for less than the cost of production. This situation developed over time as the selling price of ammonia was regulated by government and the price of naphtha, the major feedstock, was allowed to rise at a relatively fast rate. Since naphtha contributes about 70 per cnet of the ammonia selling price, the plant could not absorb the increased feedstock costs and break even.

The price of naphta was allowed to increase to reflect world energy prices. The fertilizer complex is presently charged 1,650 Syrian pounds (S£) per ton. This is equivalent to US $423 at the official exchange rate of 1$ = 3.9S£, or US $186 at Tourist official exchange rate of 1$ = 8.85 S£. If the refinery has alternate export markets willing to pay these prices the arrangement will be understandable. However, under present market conditions, it is unlikely that the refinery can realize the price charged to the fertilizer complex from any international market. A more realistic pricing transfer policy would equate the price paid by the fertilizer complex to the alternate values which can be realized by the refinery in the domestic market. It is very likely that this policy will reduce the cash flow of the refinery and show that the ammonia plant is financially viable.

Recent studies convinced the Syrian Government to use natural gas as feedstock for the production of hydrogen used in the ammonia plant. This was a sound decision. Most global new ammonia plants use natural gas. However, if natural gas price is equated to world crude oil prices on a BTU basis, the fertilizer complex will continue to appear as losing money. It is important that the price of natural gas in Homs should not be allowed to rise above the breakeven point for the ammonia plant. For comparison Saudi Arabia charges US $0.5 per thousand standard cubic feet of natural gas or million BTU of ethane. A thousand standard cubic feet of natural gas is presently selling for $3.5 on the US Gulf Coast.

B. Productivity

Ammonia: The prodctive capacity of the Ammonia plant is 1,150 tons/day, equivalent to about 380 Kt per year based on 330 operating days. The following table shows some actual operating results from 1983 and 1984.

Year / Detail	1983	1984
Ammonia production, Kt	138	145
Naphtha consumption, Kt	189	185
Hours of production		
Theoretical (330 days)	7,920	7,920
Actual	5,100	4,896
Time utilization (%)	64	62

The actual number of hours the plant was operating represented 64 and 62 per cent of the theoretical time in 1983 and 1984 respectively. The rest of the time was lost mostly because of power related problems. In practice, after every shut down, it takes some time to bring the plant to normal operating conditions. Therefore, the output, as a per cent of productive capacity, will be even lower than the time utilization. The results 1983 and 1984 show that production amounted to only 36 and 38 per cent of the productive capacity respectively. These are very low operating rates compared to similar plants operating in Western Europe, North America, Japan, Saudi Arabia, or Kuwait.

Urea: The productive capacity of the urea plant is 1,050 tons/day equivalent to about 350 Kt per year, based on 330 operating days. The following table shows some actual operating results from 1983 and 1984.

Year / Detail	1983	1984
Urea production, Kt	142	165
Ammonia consumption, Kt	82	98
Hours of production		
Theoretical (330 days)	7,920	7,920
Actual	3,646	4,371
Time utilization (%)	46	55

Time utilization of the urea plant was even lower than that of the Ammonia plant. It ammouated to 46 and 55 per cent in 1983 and 1984 respectively.

The output also was fairly low. It represented 41 and 47 per cent of the productive capacity in 1983 and 1984 respectively. These operating rates are very low compared to similar plants in Western Europe, North America, Japan, Saudi Arabia or Kuwait.

C. Operational problems:

Analysis of the plant operating record showed that the major disrupting factor is the power interruptions and surges which occur frequently. These interruptions reduce the plant output, damage the instrumentation, create a serious safety hazard, and increase the cost of manufacture of fertilizers.

We have not encountered any ammonia plant which does not have access to a reliable power source any where else. The power can originate from a reliable grid or from generators located in the plant.

For the ammonia plant in Homs to operate safely and efficiently, it is essential that it has its own electrical generating capability. Once natural gas is available in the plant, it can be used as fuel for generating electricity.

D. Waste disposal problems:

Large volumes of calcium sulfate are produced as a by-product from the superphosphate facility. This product can not be used in the plant. it is not removed from the site it can interfere with efficient operations. creates a safety hazard and reduces output. It is essential that the calcium sulfate is removed from the plant either for upgrading or disposal at another site.

THE SYRIAN REFINING SECTOR

Refining and product capacities

There are two refineries in Syria; one is located in Homs and the other in Banias.

The Homs refinery started operating in 1959, was expanded to a capacity of about 5.2 million tons per year, (equivalent to 102 KB/day), and is capable of refining a mixture of Syrian and light Arab crude oils.

The Banias refinery started in 1979 with a capacity of 6 million tons per year (equivalent to 126 KB/d). It is capable of refining a mixture of Syrian and light Arab crudes.

The following is a listing of the major units in each of the two refineries.

	Homs		Banias	
Unit	Number	Capcity KB/d	Number	Capacity KB/d
Atmospheric towers	4	102	1	126
Vacuum towers	4	7	1	54
Reformers (Gasoline)	1		1	
Naphtha hydrotreaters	1)	3	1)	17
Kerosene hydrotreaters	2)	26	1)	38
Diesel hydrotreaters	1)		1)	
LPG hydrorefiner	1)		1)	
Vis-breaker	-		1	
Mirox unit	-		1	
Coking unit	1		-	
Sulfur unit	1		1	

Based on these units, it was estimated that the Syrian productive capacity, in thousand barrels per day, for refined products is as follows:

Product	Homs	Banias	Total
LPG	1.27	3.33	4.60
Gasoline	13.84	20.85	34.69
Jet fuel (kerosene)	3.51	8.34	11.85
Kerosene	8.83	3.81	12.64
Gas oil	22.53	20.64	43.17
Fuel oil	28.48	43.91	72.39
Totals	78.46	100.88	179.34

For comparison Chart 10 contains a listing of all the refineries in the Arab world with the capacity of the unit processes in each of them.

LPG: Syrian supply and demand (Chart 11).

The demand for LPG increased from 1.24 KB/d in 1975 to 6.25 KB/d in 1983. This is equivalent to an average annual increase of 22 per cent. During the same period the productive capacity increased from 1.27 to 4.6 KB/d.

Because of the limited capacity during these years, Syria has been a net importer of LPG. The imports increased from about 440 B/d in 1975 to 1.74 KB/d in 1979. As the Banias refinery started production in 1981 imports dropped to about 570 B/d. Imports are expected to increase again to fill the shortfall between supply and demand.

Refinery modifications could reduce the LPG imports to Syria significantly.

Gasoline: Syrian supply and demand (Chart 12)

The demand for gasoline increased from about 9 KB/d in 1975 to 16 KB/d in 1983. This is equivalent to an average annual increase of about 7 per cent.

During the same period, the productive capacity for gasoline and light naphtha increased from about 14 to 35 KB/d. The units have been operating consistently at high loadings producing surplus product. Small quantities of naphtha ranging from 2 to 4.5 KB/d have been sold to the fertilizer complex. Similar small quantities have been exported. This left significant surplus volumes which could not be disposed of except as internal refinery fuel or fuel for generating electricity.

Chart 10

Arab World Refining Capacity, 1984

(kb/cd)

country	company	location	crude	vac d	crack	refor	hydro	hydror	hydrot	lubes	aspha
abu dhabi	abu dhabi national oil	ruwais	114						30.9		
abu dhabi	abu dhabi national oil	ruwais							18.7		
abu dhabi	abu dhabi national oil	ruwais							19.7		
abu dhabi	abu dhabi national oil	umm al nar 1	14			2.5			4.8		
abu dhabi	abu dhabi national oil	umm al nar 2	57			9.8			15.8		
abu dhabi	abu dhabi national oil	umm al nar 2							5.3		
algeria	sonatrach	arzew	60	6.0		8.6			8.6	1.0	2.4
algeria	sonatrach	hassi messaoud	2								
algeria	sonatrach	maison carree	60			15			15		
algeria	sonatrach	skikda	15								
bahrain	bahrain petroleum co.	awali	250	144.0	34.2	17.1		52.0	17.1		5.0
egypt	alexandria petroleum co	alexandria	105	20.3				2.1		1.9	1.2
egypt	el nasr petroleum co	alexandria	68	14.0				1.5		1.3	1.8
egypt	el nasr petroleum co	suez	71								
egypt	suez oil processing co	mostorod	84			10.8			14.0		
egypt	suez oil processing co	mostorod							14.4		
egypt	suez oil processing co	suez	19	9.0				1.5		0.5	
egypt	suez oil processing co	tanta	23								
iraq	oil refineries administration	basra	70								
iraq	oil refineries administration	daura	71			5.0			13.0	8.2	1.8
iraq	oil refineries administration	k3-haditha	7								
iraq	oil refineries administration	khanakin	12								
iraq	oil refineries administration	mufthia	5								
iraq	oil refineries administration	qaiyarah mosul	2								0.9
iraq	iraqi company for oil	kirkuk	2								
jordan	jordan petroleum refinery	zerka	100	14.8	4.4	8.6	4.2		11.9		
jordan	jordan petroleum refinery	zerka							2.0		
kuwait	arabian oil cl	ras al khafji	30								
kuwait	getty oil co	mina saud	[illegible]								
kuwait	kuwait national petroleum co	mina abdulla	98					31.2			
kuwait	kuwait national petroleum co	mina al ahmadi	250	10.0		33.1			33.1		5.0
kuwait	kuwait national petroleum co	shuaiba	195	140.0		15.0	67.0	70.0			
kuwait	kuwait national petroleum co	shuaiba					54.0	30.0			
lebanon	tripoli oil installation	tripoli	35	12.7	7.3	4.4		7.4			0.4
lebanon	mediterranean refining co	sidon	17			2.9			2.9		
libya	azzawiya oil refining co	azzawiya	120	3.4		13.0			16.9		1.7
libya	azzawiya oil refining co	azzawiya							18.7		
libya	sirte oil co	brega	5			1.0					

Chart 10 (continued)

country	company	location	crude	vac d	crack	refor	hydro	hydror	hydrot	lubes	aspha
morocco	samir	mohammedia	50			6.5		2.2	6.5		
morocco	ste cherifienne des petroles	sidi kacem	24	2.2		2.1					
oman	oman refinery co	mina al fahal	48			9.6			12.4		
qatar	national oil distribution co	umm said	63			11.8			16.1		
qatar	national oil distribution co	umm said							8.5		
qatar	national oil distribution co	umm said							12.0		
saudi arabia	arabian american oil co	ras tanura	470								
saudi arabia	jeddah oil refinery	jeddah	90	18.0	10.0	3.0			3.0		
saudi arabia	riyadh oil refinery	riyadh	130								
saudi arabia	yanbu domestic refinery	yanbu	170			35.0			35.0		
saudi arabia	yanbu domestic refinery	yanbu							15.2		
somalia	iraqsoma refinery	mogadishu	10								
sudan	port sudan refinery ltd	port sudan	24			2.1			8.9		
syria	banias refining co	banias	126	54.1		16.7			16.8		4.0
syria	banias refining co	banias							6.8		
syria	banias refining co	banias							14.3		
syria	homs refinery co	homs	102	6.5		2.6		26.0			4.0

	TOTAL	AVG
crude kb/d#	3,318.00	60.33
vac dist#	455.00	8.27
cracking c#	55.90	1.02
reforming c#	236.20	4.29
hydrocrack#	125.20	2.28
hydrorefine#	223.90	4.07
hydrotreat#	418.30	7.61
lubes#	12.90	0.23
asphalt#	28.20	0.51

Chart 11
LPG
Syrian Supply and Demand, KB/d

Year	Capacity	Production	Imports	Exports	Demand
1984	4.60	4.40			4.40
1983	4.60	3.60	0.94		4.54
1982	4.60	4.00	3.08		7.08
1981	4.60	3.90	1.37		5.27
1980	4.60	1.70	1.58		3.28
1979	1.27	1.30	2.94		4.24
1978	1.27	1.00	1.28		2.28
1977	1.27	1.00	0.87		1.87
1976	1.27	0.70	0.92		1.62
1975	1.27	0.80	0.44		1.24

Chart 12
Gasoline
Syrian Supply and Demand, KB/D

Year	Capacity	Production	Imports	Exports	Demand	Naphtha to Ammonia
1984	34.69	34.50			34.50	
1983	34.69	29.90	0.59	2.33	28.16	4.40
1982	34.69	29.40	6.83	6.03	30.20	3.70
1981	34.69	29.40	10.12	0.00	39.52	1.90
1980	34.69	26.00	7.63	12.95	20.68	1.60
1979	13.84	17.30	12.53	3.29	26.54	1.80
1978	13.84	14.50		0.00	14.50	1.80
1977	13.84	12.80		2.60	10.20	2.00
1976	13.84	7.00		2.60	10.73	1.90
1975	13.84	8.00			8.00	2.00

As the fertilizer complex converts to using natural gas as its feedstock, the refineries will have additional volumes of light naphtha which must be upgraded or used in alternate market.

Kerosene and jet fuel: Syrian supply and demand (Chart 13).

The demand for kerosene and jet fuel increased from about 10 KB/d in 1975 to 11 KB/d in 1983. This is equivalent to less than 1 per cent average annual increase.

The capacity to produce these products is more than 12 KB/d in the Homs refinery alone. With the startup of the Banias refinery in 1980, the capacity to produce kerosene increased to around 24.5 KB/d. This is far in excess of the domestic demand. Therefore Syria can look forwad to exporting significant quantities (of the order of 10 KB/d) of kerosene.

The country may keep importing small quantities where logistics make such imports attractive.

Diesel and gas oil: Syrian supply and demand (Chart 14)

The Syrian market for diesel and gas oil is the largest of all refined products. It increased from about 36 KB/d in 1975 to 56 KB/d in 1983. This is equivalent to an average annual increase of 5.7 per cent.

During the same period, the productive capacity increased from 22.5 to about 55 KB/d. The unit in the Homs refinery was operating effectively at capacity from 1977 to 1979. It produced about half of the volume needed by the domestic market. The remaining quantities, exceeding 20 KB/d, were imported.

When the Banias refinery started operations, additional volumes were produced, reducing the imports to less than 5 KB/d in 1983. However, as the demand continues to grow, it is expected that the shortfall will increase again. This shortfall can be met by imports or by refinery modifications which will increase the availability at the expense of fuel oil.

Chart 13
Kerosene and Jet Fuel
Syrian Supply and Demand, KB/D

Year	Capacity	Production	Imports	Exports	Demand
1984	24.49	8.40			8.40
1983	24.49	9.10	2.71		11.81
1982	24.49	9.30	4.66		13.96
1981	24.49	11.00	1.26		12.26
1980	24.49	10.00	1.23		11.23
1979	12.34	10.70	1.85		12.55
1978	12.34	8.90	2.35		11.25
1977	12.34	8.20	1.94		10.14
1976	12.34	7.80	3.16		10.96
1975	12.34	8.00	1.96		9.96

Chart 14
Diesel and Gas Oil
Syrian Supply and Demand, KB/D

Year	Capacity	Production	Imports	Exports	Demand
1984	55.00	57.20			57.20
1983	55.00	49.10	1.02		50.12
1982	47.00	46.10	11.00		57.10
1981	43.17	39.00	4.35		43.35
1980	43.17	30.10	5.63		35.73
1979	22.53	26.00	27.92		53.92
1978	22.53	21.40	21.83		43.23
1977	22.53	22.40	18.55		40.95
1976	22.53	14.20	25.89		40.09
1975	22.53	12.60	23.67		36.27

Fuel oil: Syrian supply and demand (Chart 15).

The demand for fuel oil increased from about 11 KB/d in 1975 to 37 KB/d in 1983. This is equivalent to an average annual increase of about 18 per cent.

During this period productive capacity increased from about 28 KB/d to about 72 KB/d. Both refineries (at Homs and Banias) are producing fuel oil at their rated capacities. At these production levels, the supply is far in excess of demand. Significant volumes (of the order of 30 KB/d) are available for export or alternate markets.

Refinery modifications could convert fuel oil into lighter fractions reducing the shortfall in diesel and the surplus of fuel oil.

Analysis of historic data

A cursory analysis of the data from 1975 to 1983, indicates that the two refineries in Syria have the capacity to produce the total volumes of refined products needed by the country. However, the supply of the individual streams does not match the market demand.

Refinery modifications could alter the product slate to better match market requirements.

Chart 15
Fuel Oil
Syrian Supply and Demand, KB/D

Year	Capacity	Production	Imports	Exports	Demand
1984	72.39	86.10			45.00
1983	72.39	77.78	3.66	36.81	44.63
1982	72.39	79.80	2.54	45.10	37.24
1981	72.39	83.90	15.31	0.00	35.00
1980	72.39	51.00	1.72	16.72	36.00
1979	28.48	36.20		4.26	31.94
1978	28.48	31.90		0.00	31.90
1977	28.48	24.30		12.60	11.70
1976	28.48	20.10		9.80	10.30
1975	28.48	15.20			15.20