current prediction are modified into 11,500,000 - 12,000,000 tons/year, reflecting strong demand of polyethylenes, and calming down of influence from export-oriented countries.

2) Propylene

Over 80% of feedstock for steam cracker has been naphtha and gas oil in Western Europe. This background is different from in the USA, and increasing propylene production is due to higher production rate of ethylene.

3) B.T.X.

The prices of benzene and toluene have been lowered, influenced by inventory adjustment in naphtha and gasoline sector, although the demand and production of B.T.X. are not changed.

4) Styrene Monomer (SM)

The followings are remarkable phenomena in SM business in Western Europe.

- European SM Plant utilization ratio has dropped by 5 - 7%, suffered by the import of the USA, Brazil and Saudi Arabia.

- Price mechanism of SM have to be reviewed widely to meet the circumstances of decrease of benzene price. Current price difference between import and domestic products has reduced by 11%, when compared that of 20% in 1985. Actual difference seems to be 8 - 9%. Users are persisting in reducing the import tariff level to 6% and now negotiating with suppliers.

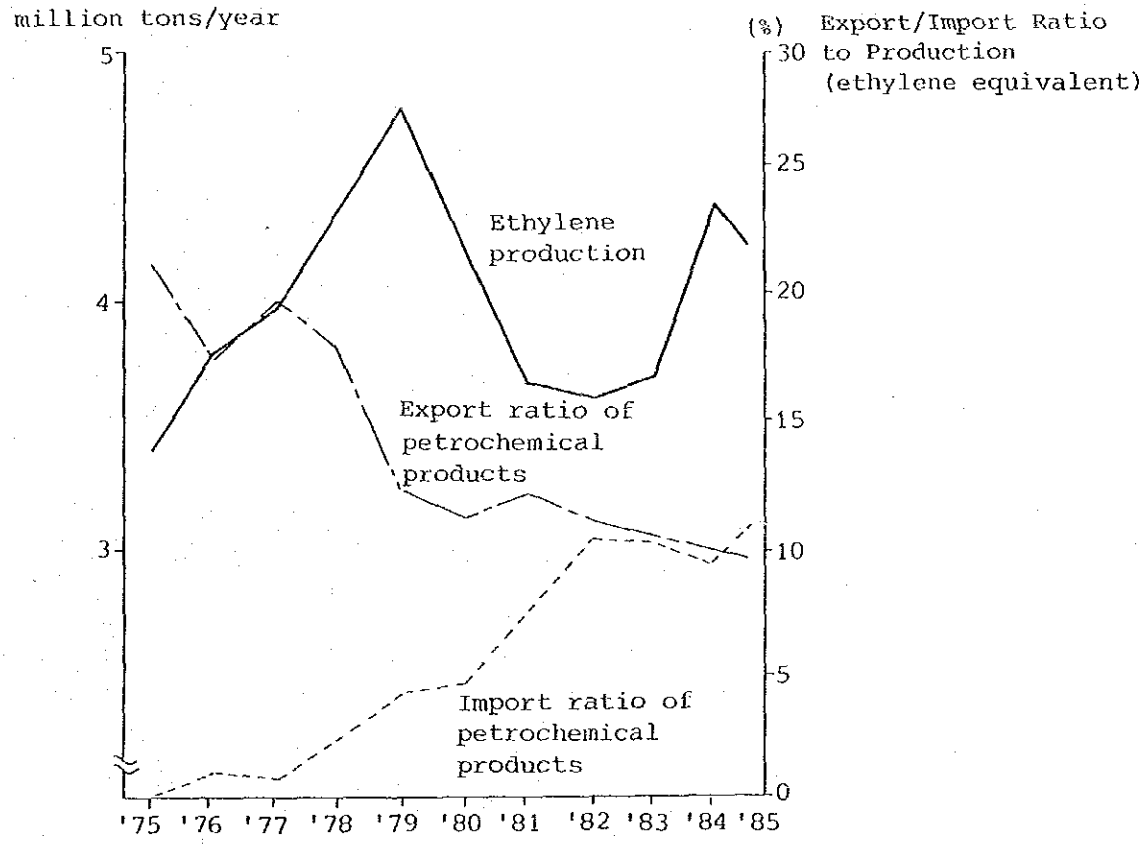
(d) Japan

Japanese economy continued to be in a favorable situation during the first half of 1985. In the latter half of the year, however, the Japanese economy passed the peak and started showing a slowdown, because of the trend of the decreasing export and inventory built-ups. Under the situation, the sharp appreciation of the yen progressed after the meeting of finance ministeres of the five countries in September 1985. There has been concern about the acceleration of a slowdown of the economic activities due to the deflationary pressures caused by the rapid appreciation of the yen.

Regarding the Japanese petrochemical industry during 1985, the domestic demand for petrochemicals was strong and the production of ethylene amounted to 4.2 million tons. The amount was smaller than 4.4 million tons of the previous year, but was higher than previously expected. When we examine the background of such favorable performance in detail, we notice that it was the outcome brought about by a number of favorable factors. Above all, when the demand for petrochemicals was expanding in the world, a series of unexpected accidents occurred in Europe, which caused the temporary shortage of the production capacity, and in addition to that, the shipment of petrochemicals from the newly completed production facilities in the Middle Eastern countries was delayed.

However, such a situation is only temporary and the basic trend of petrochemical demand-supply structure in the world remains unchanged. In fact, if we take a look at the trend of the petrochemical trade in detail, which the Japanese petrochemical industry is keenly concerned about, there was a remarkable increase of the import of the petrochemicals into Japan on the other hand the export of petrochemicals from Japan was declining, that caused the large excess of petrochemical import in terms of ethylene. It was for the first time in 25 years since 1961 when the Japanese petrochemical industry started (Figure III-2-4, Table III-2-9).

Figure III-2-4 Changes in the Petrochemical Production in Japan



Source: Japan Petrochemical Industry Association

(e) Mexico

1) The Mexican government had to take a fiscal retrenchment suffered from foreign debt of US$97.6 billion in 1985. Moreover, the Mexican economy has been damaged severely by big earthquake in September 1985 and plunging oil price since January 1986. Thus, most of petrochemical construction projects have to be interrupted or postponed.

The Mexican government announced development policy for non-oil export and they expect to export petrochemical products. But unstable supply of feedstock by PEMEX becomes the constraints for that policy.

Table III-2-9 Changes in Production, Exports & Imports of Main Products in Japan

(1,000 tons)

	Production			Imports			Exports		
	1983	1984	1985	1983	1984	1985	1983	1984	1985
LDPE	1,084.6	1,049.8	1,242.6	37.0	26.7	57.2	124.8	112.0	70.5
HDPE	688.4	841.3	784.7	2.3	1.8	5.7	124.5	185.3	186.0
PP	1,062.1	1,271.5	1,303.8	7.8	4.5	11.2	100.6	97.9	108.5
PS	703.8	819.0	894.8	23.1	19.5	16.5	109.1	155.3	156.7
PVC	1,420.4	1,503.8	1,549.5	71.8	77.3	107.8	53.7	56.4	70.2
Total main 5 resins	4,959.3	5,485.4	5,775.4	142.0	129.8	198.4	512.7	606.9	591.9
EG	375.5	428.8	439.8	158.7	186.5	169.2	21.8	39.4	20.9
SM	1,167.2	1,423.3	1,418.1	118.7	132.2	193.4	2.0	5.1	9.3
AN	459.1	522.5	540.9	121.5	106.7	118.0	11.6	20.9	23.7

Source: Japan Petrochemical Industry Association
Note : 1) LDPE production includes ethylene vinyl acetate copolymers.
2) In PS exports, all styrene copolymer resins are included, except for ABS.

2) There were no damage in petrochemical industry by the earthquake, but current plant utilization is low due to a lot of operational troubles in PEMEX plants. Thus, petrochemical intermediates such as styrene monomer and polystyrene have been imported and that situation seem to be continued.

3) Recently, the government discussed to quit import of raw materials for petrochemicals through PEMEX, aiming at direct import by private organization.

4) Plans for starting up of new petrochemical plants

PEMEX

- The LDPE plant in La Cangrejera (80,000 tons/year) is starting up in April or May 1986. By this starting up, they will be able to have enough surplus to export.

- The acrylonitrile plant in San Martin Texmelucan (50,000 tons/year) will start up at the end of 1986 or the beginning of 1987. They will be able to alternate the imported acrylonitrile by this plant.

- Morelos complex (Ethylene 500,000 tons/year, Propylene 350,000 tons/year, Butadiene (100,000 tons/year) will be completed after 1987.

Private sector

The phthalic acid plant of PRIMEX will be started up after July, 1986. It is estimated that 60% of output will be exported.

(f) Republic of Korea

1) Situation in 1985

The Korean economy, which had grown by 7.6% in 1984, registered a lower growth rate of 5.1% in 1985, mainly due to the slowdown of the world economy. Despite this economic slowdown the petrochemical industry in Korea managed to continue a steady growth in 1985. Demand of petrochemical products increased by 10% in 1985, considerably over the economic growth. This growth seems to be modest in comparison with 20% in 1983 and 16% in 1984, respectively. Taking account of unfavorable circumstances such as the matured domestic market, this growth rate represents a relatively satisfactory performance.

Meanwhile demand of the synthetic resins and the synthetic fiber intermediates recorded 10% and 11% growths, respectively. In case of the synthetic rubbers, the demand registered a zero growth due to the impact of low-priced natural rubbers and stagnant export of tires.

Exports of petrochemical products in 1985 increased greatly, led mainly by the synthetic resins. This increase was attributable to the business upturn in South East Asia, decrease of shipments from the European countries to this area, and extensive export efforts of the expanded domestic producers to maintain higher operation rates through developing export markets (Table III-2-10).

The increase of domestic and export demands enabled almost all of petrochemical plants to maintain higher operation rate again in 1985. Production of ethylene in 1985 increased by 6.9% to 561,000 tons from 525,000 tons in 1984 by skipping the scheduled annual turnaround of the naphtha cracker in Yochon (Table III-2-11).

Production of three major petrochemical products such as synthetic resins, fiber intermediates and synthetic rubbers increased by 14% to an aggregate total of 1.71 million tons in 1985 from 1.51 million tons in 1984. The synthetic resins recorded a 19% increase whereas the fiber intermediates showed only a 3% increase due to the limited production capacities and a 17% increase of imports for reexport purpose. Production of synthetic rubbers maintained the same level as the previous year.

Table III-2-10 Supply and Demand for Major Petrochemicals

(1,000 tons)

By Products	1983	1984	1985	Change (%) 84/83	Change (%) 85/84
Syn. Resins					
Production	921	1,055	1,252	15	19
Import	105	120	122	14	2
Export	152	157	253	5	61
Domestic Consumption	874	1,018	1,121	16	10
Fiber Intermediates					
Production	345	351	361	2	3
Import	440	574	670	30	17
Export	2	2	6	0	275
Domestic Consumption	783	923	1,025	18	11
Syn. Rubbers					
Production	90	99	99	10	0
Import	13	13	14	1	6
Export	11	12	13	9	9
Domestic Consumption	92	100	100	9	0
Total					
Production	1,356	1,505	1,712	11	14
Import	558	707	806	27	14
Export	165	171	272	5	59
Domestic Consumption	1,750	2,041	2,245	16	10

Source: Korea Petrochemical Industry Association
Notes : 1. Synthetic Resins include LDPE, HDPE, PP, PS ABS, and PVC.
2. Synthetic Fiber Intermediates include Caprolactam, AN, TPA, and EG.
3. Synthetic Rubbers include SBR and BR only.

The total import of the these three major products amounted to 805,000 tons, 14% increase over the previous year. The increased import was attributable to an absolute shortage of the synthetic fiber intermediates in particular.

Table III-2-11 Production of Ethylene in Korea

(1,000 tons)

Year	Production	Nameplate Capacity	Operation Rate (%)
1982	373	505	74
1983	491	505	97
1984	525	505	104
1985	561	505	111
I Q	141		112
II Q	132		105
III Q	141		112
IV Q	147		116

Source: Korea Petrochemical Industry Association

As for production capacities, Yokong's new aromatics plant came on-stream in December, 1985, increasing the BTX production capacity significantly. Petrochemical downstream facilities have no substantial change except for some small expansions of PVC and ABS.

2) Prospect for 1986

Korean Petrochemical Industry expects a stable growth again in 1986. The growth rate of the Korean economy in 1986 is expected to be higher than that of the previous year. Major factors behind this improvement are a cheaper oil, Government policy for investment incentives, and declining interest rates. Accordingly, it can be expected that the Government target of 7% in real GNP growth will be achieved.

The Korean petrochemical industry, although it is reaching to matured stage, will grow at a similar rate of 10% as in the last year, with expectation of an improved business environment such as declining oil prices.

As to the petrochemical market, it is apparent that the import of low-priced petrochemical products will make partial penetration in domestic markets since petrochemical plants in Saudi Arabia will begin full operations first time in 1986. However, most of the petrochemical plants in Korea are believed to maintain high operation rate due to a steady demand growth in domestic market.

In the investment aspect, LLDPE and SM plants of 80,000 tons/year capacity each will be soon completed or ready for commissioning at present. There will be some movement in the already announced new projects for two naphtha crackers in Ulsan and Yochon and assorted downstream plants in 1986.

The petrochemical industry in Korea has still several problems. World-wide excessive petrochemical capacities have been reduced, but will not be solved completely due to the addition of Saudi products in the world market. Threats of low-priced imports seems to continue for a while. The Korean petrochemical producers face some difficulties in competition with low-priced imports. The situation will continue because the government advocates free trade, together with reduction of tariff rate as well as investment liberalization. As for raw materials, temporary shortage of the naphtha is expected to occur gradually due to higher operation rates of petrochemical plant and further expansion of petrochemical facilities. The stable supply of raw materials will be another problem to be solved.

The Korean petrochemical industry will make efforts to enhance the competitiveness through productivity increase and/or technological development, and more secured supply of raw materials. The recent decline of oil prices will be a great help to improve competitiveness of the petrochemical industry in non oil producing countries.

2-2-3 Forecast of Future Trend

Many organizations are disclosing various forecast for demand of international petrochemical products, of which data of Stanford Research Institute (SRI) seems to be most reliable. The SRI uses a prediction scheme by accumulating data through hearing from petrochemical industries in various countries which covers all nations in the world except those in the communist block. Since SRI data are summarized by country, we have re-arranged the data by products, major countries, and local areas to be useful as fundamental data. We also used other data for comparison of demand growth.

These data are based on forecasts made in 1984 and 1985, and do not reflect the current oil situation in 1986 under which material cost is decreasing. Table III-2-12 shows the demand forecast of major petrochemical products.

(1) Demand of ethylene and its derivatives

(a) Ethylene

Ethylene is the most fundamental petrochemical product. It is also the intermediate material, supporting the production of 75% of petrochemical industry, it can be used as a measure to indicate the scale of a nation's petrochemical industry. In recent years, nations having their own resources are producing ethylene from natural gas ethane and rapidly expanding their shares in the market. Meanwhile, advanced industrial nations having no natural resources are disposing their ethylene production facilities. Plastic, which is the major ultimate product of ethylene, is used as the basic input for automobile, electric appliance, packaging, agriculture and many other industries and the growth of its demand in general is almost the same

Table III-2-12 Demand Trends and Forecasts of Major Petrochemical Products in the World

	Quantity (1,000 tons)					Growth rate (%/Y)			
	1974	1980	1984	1989	1994	1980/1974	1984/1980	1989/1984	1994/1989
Ethylene	26,932	32,077	36,787	40,620	45,165	2.9	3.4	2.0	2.1
1 LDPE	8,021	9,768	11,114	12,467	14,305	3.3	3.2	2.3	2.7
1 HDPE	3,249	4,741	5,961	7,326	8,763	6.5	5.8	4.2	3.6
1 Polyvinyl chloride	7,955	9,449	10,851	12,635	14,705	2.8	3.5	3.0	3.0
Styrene monomer	6,308	7,351	8,413	9,818	11,247	2.5	3.4	3.1	2.7
2 Ethylene oxide	3,863	4,669	5,314	6,099	6,620	3.2	3.2	2.7	1.6
2 Ethylene glycol	2,893	3,806	4,007	4,442	4,943	4.6	1.2	2.0	2.1
Propylene	13,111	16,391	19,684	21,849	24,844	3.7	3.8	2.7	2.6
1 Polypropylene	2,642	4,383	5,980	7,621	9,556	8.8	8.0	4.9	4.6
2 Acrylonitorile	2,022	2,471	2,793	3,272	3,605	3.3	3.1	3.2	1.9
2 Phenol	2,434	2,430	2,678	2,998	3,334	-0.0	2.4	2.2	2.1
2 2-Ethyl hexanol	556	1,241	1,381	1,460	1,598	14.3	2.7	1.1	1.8
2 Aceton	1,948	1,971	2,070	2,377	2,698	0.1	1.2	2.8	2.5
Benzene	12,310	13,183	13,886	15,972	17,806	1.0	1.4	2.8	2.1
1 Polystyrene	3,937	5,312	5,375	6,081	7,086	5.1	0.2	3.1	3.1
2 Caprolactam	1,440	1,659	1,672	1,876	2,104	2.3	0.1	2.3	2.3
1 ABS	857	1,088	1,427	1,852	2,278	4.0	7.0	5.3	4.2
1 SBR	3,677	3,632	3,546	4,163	4,741	-0.2	-0.5	3.2	2.6
2 Phthalic anhydride	1,472	1,510	1,652	1,870	2,135	0.4	2.2	2.5	2.6
2 Maleic anhydride	305	343	382	472	571	1.9	2.7	4.3	3.8
2 Terephthalic acid	1,202	2,291	2,442	3,476	4,136	17.4	1.6	7.3	3.5
Butadiene	4,266	3,746	3,975	4,573	5,200	-2.1	1.4	2.8	2.6
MTBE	36	568	1,368	1,936	2,130	58.3	24.5	7.1	1.9
1 Thermo plastics total	30,338	38,364	44,254	52,145	61,434	3.9	3.6	3.3	3.3
2 Chemicals total	18,135	22,391	24,391	28,342	31,744	3.5	2.1	3.0	2.2

Source: SRI International, World Petrochemical, 1984

as the growth of worldwide GNP. Table III-2-13 shows comparison of various forecast data on ethylene demand and Table III-2-14 shows the predicted growth rate in the latter half of the 1980s and in the first half of the 1990s.

According to the forecast the international demand will increase from 36,787 thousand tons in 1984 to 40,620 thousand tons in 1989. Increase in the period is 3,833 thousand tons which corresponds to 2.5 times of the total production (1,611 thousand tons) of the greatest new project in Saudi Arabia. The international demand will reach 45,165 thousand tons in 1994. Increase from 1984 is 8,378 thousand tons, which is almost equal to the demand of Western Europe in 1984.

(b) Ethylene derivatives

Major derivatives are low-density polyethylenes (LDPE and LLDPE), high-density polyethylene (HDPE), polyvinyl chloride (PVC), styrene (SM), ethylene oxide (EO), and ethylene glycol (EG). Table III-2-15 shows the forecast of demand increases of ethylene derivatives and growth of demand between 1984 and 1994.

According to this forecast, plastics (HDPE, PVC, LDPE and LLDPE) and intermediates of plastics (SM) may exceed ethylene in their growth of demand. The increase of demand of each derivative is expected to be 3 to 4 million tons in ten years of 1984 to 1994.

Table III-2-13 Comparison of Existing Forecasts of Supply - Demand (Ethylene)

		Growth Rate in 1980s(1989/1984)					Growth Rate in 1990s (1994/1989)	
		S R I 1984	Dewitt 1985	H P I 1985	P T E C 1984	B P 1985	S R I 1984	Dewitt 1985
North America	SUP	0.7			2.4		2.4	
	DEM	0.7	4.2				2.4	1.9
Latin America	SUP	4.2			1.6		4.3	
	DEM	4.8	2.2				5.1	5.1
Western Europe	SUP	1.3			-0.5		0.8	
	DEM	1	0.7				0.8	1.4
Eastern Europe	SUP				3.2			
	DEM		4					5.9
Asia & Oceania	SUP	1.6			3.7		2.6	
	DEM	2	2.8				2.9	3.6
Mid. East & Africa	SUP	88.4			25.4		0.7	
	DEM	88.4	35.4				0.7	5.4
Industrial Area	SUP	0.8			1		1.7	
	DEM	0.7	2.4				1.8	
Developing Area	SUP	9.9			6.6		3.8	
	DEM	10.6	8.5				3.8	
World Total	SUP	2			2.5		2	
	DEM	2	3.6	3.5		MIN. 3	2.1	2.7
Volume in 1989 & 1994 (1,000T/Y)	SUP	40,719			47,587		45,020	
	DEM	40,620	45,582	45,401		44,315	45,165	51,983

Note: SRI= Stanford Research, HPI= Hydrocarbon Processing, PTEC= Parpinelli TECNON, BP= British Petroleum.

Table III-2-14 Annual Growth Rate of Ethylene Demand

(%)

	1989/1984	1994/1989
World total	2.0 - 3.6	2.1 - 2.7
Industrialized countries	0.7 - 2.4	1.8
Others	8.5 - 10.6	3.8

Source: SRI and others

(2) Demand of propylene and its derivatives

(a) Propylene

Propylene, the fundamental petrochemical product next to ethylene, can not be produced from natural gas ethane. It is normally produced as a petrochemical by-product in steam crackers of gas oil, naphtha, and LPG, or refinery by-product in fluid catalytic crackers (F.C.C.). With this different nature of production from that of

Table III-2-15 Share and Growth Rate of Ethylene Derivatives

Derivatives	Share (%)		Demand Increase (million tons)	Annual Growth Rate (%)
	1984	1994	1984/1994	1994/1984
LDPE-LLDPE	30.2	31.7	3.191	2.56
HDPE	16.7	20.0	2.802	3.93
PVC	13.9	15.3	3.854	3.09
SM	6.6	7.2	2.834	2.95
EO	13.0	13.2	1.300	2.22
(EG)	(7.8)	(7.9)	0.936	2.12
Others	19.6	12.6	-	-
Total	100.0	100.0	-	2.07

Source: Stanford Research Institute
Note : EG, a derivative of EO, is not included in the total.

ethylene, petrochemical industries using liquid raw material in Western Europe and Japan are able to survive in the propylene business. Nations having their own natural resources such as Mexico, Thailand, and Saudi Arabia have their propylene production plans by applying dehydrogenation of LPG propane.

The demand of propylene is expected to grow at a higher rate than that of ethylene reflecting the fact that the former's derivatives such as polypropylene has higher potential of growth than polyethylenes. Table III-2-16 compares various forecast data on propylene demand. Table III-2-17 shows the growth forecast in the latter half of the 1980s and in the first half of the 1990s.

From the forecast, the world demand will increase from 19,084 thousand tons in 1984 to 21,849 thousand tons in 1989. The increase in this period of 2,765 thousand tons is almost equal to the 1984's demand in Japan. The world demand will reach 24,844 thousand tons in 1994. The increase from 1984 is 5,760 thousand tons, which is almost equal to the 1984's demand in Western Europe.

(b) Propylene derivatives

Main derivatives are polypropylene (PP), acrylonitrile (AN), phenol (PL), octanol (OL) and aceton (AC). Table III-2-18 shows the forecast of demand increases of propylene derivatives and growth of demand between 1984 and 1994. The growth of demand is greatest with polypropylene, indicating that the increase of demand of 3.5 million

Table III-2-16 Comparison of Existing Forecasts of Supply - Demand (propylene)

(%/Y)

		Growth Rate in 1980 s(1989/1984)						Growth Rate in 1990s(1994/1989)	
		S R I 1984	DeWitt 1985	H P I 1985	P T E C 1984	B P 1985		S R I 1984	DeWitt 1985
North America	SUP	2.3	2.7					2.5	5.1
	DEM	2.4	2.9					2.5	4
Latin America	SUP	8.4	5.9					5.4	2.4
	DEM	6	3.9					5.4	4
Western Europe	SUP	0.9	2.2					0.4	2.1
	DEM	1.5	2.4					1.6	2.6
Eastern Europe	SUP								
	DEM								
Asia & Oceania	SUP	3.6	3.5					3.2	3.7
	DEM	3.8	3.5					3.5	3.2
Mid. East & Africa	SUP	47.4	14.9					1.2	4.6
	DEM	47.4	8.4					1.2	3.1
Industrial Area	SUP	1.8	2.3					1.9	3.3
	DEM	2.1	2.7					2.3	3.2
Developing Area	SUP	8.8	7.7					4.4	6.4
	DEM	8.1	4.5					4.9	3.7
World Total	SUP	2.5	2.8					2.2	3.3
	DEM	2.7	3					2.6	3.3
Volume in 1989 & 1994 (1,000T/Y)	SUP	21,350	21,474					23,774	25,287
	DEM	21,849	21,474					24,844	25,287

Notes: SRI=Stanford Research, HPI= Hydrocarbon Processing, PTCE= Parpinelli TECNON, BP= British Petroleum.

Table III-2-17 Annual Growth Rate of Propylene Demand

(%)

	1989/1984	1994/1989
World Total	2.7 - 3.0	2.6 - 3.3
Industrialized Countries	2.1 - 2.7	2.3 - 3.2
Others	4.5 - 8.1	3.7 - 4.9

Source: Stanford Research Institute and others

tons can be expected in ten years of 1984 to 1994, which exceeds the increase with the most significant plastic, low-density polyethylene.

(3) Demand of benzene and its derivatives

(a) Benzene

Benzene, an aromatic product, is produced from steam cracking of liquid raw material in petrochemical industry, reforming process in refinery and condensation of natural gas as well as from coal chemicals. Since the consumption is not limited to petrochemicals but

Table III-2-18 Share and Growth Rate of Demand for Propylene Derivatives

Derivatives	Share (%)		Demand Increase (million tons)	Annual Growth Rate (%)
	1984	1994	1984/1994	1994/1984
PP	34.4	42.3	3.576	4.80
AN	16.8	16.7	0.812	2.58
PL	4.1	3.9	0.656	2.22
OL	6.5	5.8	0.217	1.47
AC	1.8	1.8	0.628	2.69
Others	36.6	29.5	-	-
Total	100.0	100.0	-	2.7

Source: Stanford Research Institute

is also used as constituents of gasoline, it is a product difficult to grasp correct figures of the demand.

With respect to the use for petrochemical industry, because the demand for polystyrene which is the most significant derivative, has a higher growth rate than that of polyethylene, the demand for benzene is expected to grow at a higher rate than that of ethylene. Table III-2-19 shows the forecast of growth in the latter half of 1980s and in the first half of the 1990s.

Table III-2-19 Annual Growth Rate of Demand for Benzene

	(%)	
	1989/1984	1994/1989
World Total	2.8	2.2
Industrialized Countries	1.8	1.7
Others	11.2	5.0

Source: Stanford Research Institute

Accordingly it indicates that the world-wide demand growth from 13,886 thousand tons in 1984 will be 15,972 thousand tons in 1989. Increase in this period of 2,086 thousand tons is almost equal to the 1984's demand in Japan. The world-wide demand will reach 17,806 thousand tons in 1994. The amount of increase from 1980 to 1994 of 4,703 thousand tons is almost equal to the 1984's demand in Western Europe (see Table III-2-12 above).

(b) Benzene derivatives

Main derivatives are polystyrene (PS), caprolactam (CPL), ABS, and SBR. Table III-2-20 shows the forecast of demand increases of benzene derivatives and growth of demand between 1984 and 1994.

Table III-2-20 Share and Growth Rate of Benzene Derivatives

Derivatives	Share (%)		Demand Increase (million tons)	Annual Growth Rate (%)
	1984	1994	1984/1994	1994/1984
PS	29.8	30.6	1.711	2.80
CPL	11.9	11.7	0.432	2.32
ABS	3.8	4.7	0.851	4.79
SBR	4.9	5.1	1.195	2.95
Others	49.6	47.9	-	-
Total	100.0	100.0	-	2.52

Source: Stanford Research Institute

Growth of demand for ABS is expected to be about the same as polypropylene, and SBR and PS are expected to higher growth than low-density polyethylene.

2-2-4 Comparison of International Cost Competitiveness

Before the first oil crisis, the petrochemical industry was a capital intensive industry with high fixed cost, reflecting the background of relatively cheap prices of raw materials and energy and a huge amount of construction cost. Thus, almost all petrochemical plants were located near market in industrialized countries. To enjoy the scale of economy, the scale of petrochemical plants quickly expanded to 300,000 tons per year or more for ethylene and 50,000 tons per year for polyethylene. However, the first and second oil crises made the oil price increase from about one dollar per barrel before 1973 to US$34 per barrel. The accompanying increase of the raw material and energy

energy prices made the petrochemical industry change into a raw-material oriented industry with a high variable-cost ratio. As a result, petrochemical industries in resource-rich countries has been highlighted recently, and new plants has been realized one after another in Canada, Saudi Arabia and Mexico.

The current decrease of the oil price again gives a great impact on the petrochemical industry. To study the possibility for development of petrochemical industry, one must compare the cost competitiveness among various areas in the world, based on the current prices of raw materials and energy.

(1) Assumptions for cost calculations

The main objective in this cost calculation is comparing potentialities in cost competitiveness among various countries. Thus, we calculated general production cost, ignoring specific conditions in details. The costs are calculated on the basis of Handbook for Forecasting Costs of Chemical Products (1985) issued by CMC in Japan, modifying with prices of raw materials and energy in June 1986.

The followings are premises for cost calculations.

1) Petrochemical products to be examined

- Ethylene and its derivatives: Ethylene, Linear Low Density Polyethylene (LLDPE), High Density Polyethylene (HDPE), Polyvinyl, Chloride (PVC), Styrene (SM)

- Propylene derivatives: Polypropylene (PP), Acrylonitrile (AN), Octanol (OL)

- Benzene derivatives: Polystyrene (PS), Caprolactam (CPL), ABS

- Others: MTBE, Methanol, Ammonia, Urea

2) Countries and area to be examined

Japan, Western Europe, the USA, Argentina, NICs, Saudi Arabia

3) Construction costs

a) We have adopted the CMC's construction costs for inside of battery limits (ISBL), estimated on the basis of published value in chemical engineering journals available in Japan.

b) We have set up standard scale for each products on the basis of our experience. Then construction costs of the standard scale are calculated from the published value, introducing 0.7 as scale factor.

c) The construction costs for outside battery limits (OSBL) are calculated as 50% of ISBL.

d) Definitions for existing plants and new plants are as follows:

Existing plants	Starting up in 1980
New plants	Starting up in 1986

e) Location factor is applied to Argentina and Saudi Arabia and its figure is 1.3 times of the US Gulf Coast price, generally.

4) Plant operating rates

Plant operating rates are set to be equal (80%), although CMC set up these factors individually, region by region in the world.

5) Costs of raw materials and utilities

a) The prices of raw materials, byproducts and energy are mainly based on the market price in June, 1986, but some data are on the basis of net production costs of upstreams.

b) Utilities costs are calculated from energy cost relatively.

c) Unit consumption of raw materials and utilities are also estimated from published data in chemical journals available in Japan.

d) The followings are cost calculation formulae of raw materials and utilities.

Raw materials cost = (Unit prices) x (Unit consumption of raw materials)
Utilities cost = (Unit prices) x (Unit consumption of utilities)
Byproduct credit = (Unit prices) x (Unit production of byproducts)

6) Labor cost

Labor cost is also calculated from CMC's data. The CMC's data are consisted of number of labor per shift, and we have estimated by five times of this number of labor as a total labor.

7) Other fixed costs

These are calculated as follows:[1)]

Maintenance cost	= (ISBL) x 0.06	Annual production
Depreciation	= (ISBL) x 0.1	Annual production
Tax and Insurance	= (ISBL) x 0.02	Annual production
Plant overhead	= (ISBL) x 0.02	Annual production
Interest	= (ISBL) x 0.05	Annual production

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1) ROI = Return on Investment, ISBL = Inside of Battery Limit, OSBL = Outside of Battery Limit

Sales, G & A = (ISBL) x 0.04 Annual production
(Except for polymers)
= (ISBL) x 0.08 Annual production
(Polymers)
ROI = (ISBL + OSBL) x 0.15 Annual production

8) Transfer price

Transfer price is calculated as follows:

Transfer price = (Raw materials cost) + (Utilities cost)
- (Byproduct credit) + (Labor cost)
+ (Maintenance cost) + (Depreciation)
+ (Tax and Insurance) + (Plant overhead)
+ (Interest) + (Sales, G & A) + (ROI)

(2) Results of cost calculation

Table III-2-21 shows the result of cost competitiveness in various countries and areas. Table III-2-22 shows cost competitiveness in various countries and areas, when compared to the cost in Western Europe. As a result, the cost competitiveness in various countries can be summarized as follows (For details see Appendix 2-A-3):

Japan: Cost is 2 to 5% higher than that of Western Europe in general.

USA: Cost is 5 to 10% lower than that of Western Europe in general.

Argentina: The cost competitiveness in propylene derivatives and natural gas derivatives are having high potentials.

NICs: Cost is 1 to 2% higher than that of Western Europe in general.

Saudi Arabia: The cost competitiveness is having highest potentials except some products.

Thus, the countries having the highest cost competitiveness is the USA among industrialized countries, and Saudi Arabia among resource-rich countries. However, nowadays price decrease of raw material is making the ratio of fixed cost to the total cost higher. Therefore, the low variable cost (i.e., the cost of raw material and energy) does not always mean cost competitiveness.

2-2-5 Petrochemical Industry Development Policies in Selected Countries

There are various risks to realize the development of petrochemical industry, mainly because of huge investment cost. For the activation of the investment, favorable incentive policies should be introduced. Here, we would like to compare incentive policies related to the petrochemical industry in selected Latin American countries (Argentina,

Table III-2-21(1) Cost Comparison of Petrochemical Products (1986)

			Japan		U S A		W Europe		N I C S		SaudiArabia		Argentina	
	Product	Cost	$/t	%	$/t	%	$/t	%	$/t	%	$/t	%	$/t	%
1	Ethylene	Variable cost	147.5	33.3	135.3	35.5	139.5	32.0	138.4	30.5	45.2	9.8	85.2	20.2
2	(Cap.450000t/y)	Fixed cost	167.1	37.7	139.2	36.5	167.7	38.5	177.7	39.1	234.6	50.8	189.1	44.9
3		R O I	128.1	28.9	106.2	27.8	128.1	29.4	137.4	30.2	181.2	39.3	146.2	34.7
4		Transfer price	442.7	100.0	380.7	100.0	435.3	100.0	453.5	100.0	461.0	100.0	420.5	100.0
5	LLDPE	Variable cost	569.3	64.3	454.6	58.8	538.5	62.9	537.0	63.3	269.8	40.8	468.8	54.6
6	(Cap.100000t/y)	Fixed cost	180.0	20.3	182.4	23.6	181.6	21.2	175.5	20.7	221.2	33.5	219.7	25.6
7		R O I	135.0	15.2	135.0	17.4	135.0	15.7	135.0	15.9	168.7	25.5	168.7	19.6
8		Transfer price	884.3	100.0	772.0	100.0	855.1	100.0	847.5	100.0	659.7	100.0	857.2	100.0
9	HDPE	Variable cost	554.8	54.6	448.7	49.0	528.1	53.2	525.2	52.1	261.5	29.8	447.0	42.3
10	(Cap.100000t/y)	Fixed cost	280.0	27.5	286.5	31.3	284.5	28.6	288.6	28.6	368.8	42.1	364.8	34.5
11		R O I	180.0	17.7	180.0	19.6	180.0	18.1	194.0	19.2	244.6	27.9	244.6	23.1
12		Transfer price	1014.8	100.0	915.2	100.0	992.6	100.0	1007.8	100.0	874.9	100.0	1056.4	100.0
13	PVC	Variable cost	661.1	62.1	535.5	56.8	627.5	60.7	624.9	59.5	308.7	36.1	530.4	49.3
14	(Cap.100000t/y)	Fixed cost	243.1	22.8	246.3	26.1	245.3	23.7	253.6	24.1	326.7	38.2	324.7	30.2
15		R O I	160.3	15.0	160.3	17.0	160.3	15.5	171.5	16.3	219.3	25.6	219.3	20.4
16		Transfer price	1064.5	100.0	942.1	100.0	1033.1	100.0	1050.0	100.0	854.7	100.0	1074.4	100.0
17	SM	Variable cost	484.7	76.3	427.8	73.9	458.2	75.2	456.8	74.4	235.3	53.5	409.5	66.8
18	(Cap.200000t/y)	Fixed cost	85.3	13.4	86.1	14.8	85.9	14.1	88.4	14.4	115.4	26.2	114.9	18.7
19		R O I	64.6	10.1	64.6	11.1	64.6	10.6	68.2	11.1	88.5	20.1	88.5	14.4
20		Transfer price	634.6	100.0	578.5	100.0	608.7	100.0	613.4	100.0	439.2	100.0	612.9	100.0
21	PP	Variable cost	366.4	59.7	345.1	58.1	348.0	58.3	346.7	58.7	267.6	45.6	162.3	33.8
22	(Cap.100000t/y)	Fixed cost	148.3	24.1	150.0	25.2	149.5	25.0	145.3	24.6	190.1	32.4	189.1	39.4
23		R O I	98.4	16.0	98.4	16.5	98.4	16.5	98.4	16.6	127.9	21.8	127.9	26.6
24		Transfer price	613.1	100.0	593.5	100.0	595.9	100.0	590.4	100.0	585.6	100.0	479.3	100.0

Source: Study Team

Table III-2-21(2) Cost Comparison of Petrochemical Products (1986)

			Japan		U S A		W Europe		N I C S		SaudiArabia		Argentina	
	Product	Cost	$/t	%	$/t	%	$/t	%	$/t	%	$/t	%	$/t	%
1	AN	Variable cost	588.6	57.8	533.0	55.3	561.8	56.6	558.9	55.3	389.7	40.1	359.6	38.2
2	(Cap.100000t/y)	Fixed cost	243.2	23.9	244.8	25.4	244.3	24.6	254.7	25.2	328.7	33.8	327.7	34.8
3		R O I	185.6	18.2	185.6	19.2	185.6	18.7	196.8	19.4	253.1	26.0	253.1	26.9
4		Transfer price	1017.4	100.0	963.4	100.0	991.7	100.0	1010.4	100.0	971.5	100.0	940.4	100.0
5	2-ETHYLHEXANOL	Variable cost	600.3	52.6	494.4	47.5	551.7	50.3	549.0	49.6	325.7	30.8	302.8	29.4
6	(Cap. 50000t/y)	Fixed cost	309.2	27.1	314.1	30.2	312.6	28.5	314.7	28.4	413.5	39.2	410.5	39.9
7		R O I	230.6	20.2	230.6	22.1	230.6	21.0	241.8	21.8	315.0	29.8	315.0	30.6
8		Transfer price	1140.1	100.0	1039.1	100.0	1094.9	100.0	1105.5	100.0	1054.2	100.0	1028.3	100.0
9	PS	Variable cost	608.3	62.8	578.0	61.0	581.3	61.3	572.2	61.4	378.7	44.6	569.3	55.0
10	(Cap. 50000t/y)	Fixed cost	222.1	22.9	230.2	24.3	227.7	24.0	215.3	23.1	284.7	33.5	279.7	27.0
11		R O I	137.8	14.2	137.8	14.5	137.8	14.5	143.4	15.4	185.6	21.8	185.6	17.9
12		Transfer price	968.2	100.0	946.0	100.0	946.8	100.0	930.9	100.0	849.0	100.0	1034.6	100.0
13	CAPROLACTAM	Variable cost	1182.8	59.8	1017.0	55.9	1086.6	57.6	1099.6	57.0	780.7	41.9	1054.6	49.4
14	(Cap. 50000t/y)	Fixed cost	455.0	23.0	463.1	25.4	460.6	24.4	469.0	24.3	614.2	32.9	609.2	28.5
15		R O I	337.5	17.0	337.5	18.5	337.5	17.9	360.0	18.6	466.8	25.0	466.8	21.9
16		Transfer price	1975.3	100.0	1817.6	100.0	1884.7	100.0	1928.6	100.0	1861.7	100.0	2130.6	100.0
17	ABS	Variable cost	924.6	55.2	855.8	53.0	866.7	53.4	869.4	52.6	724.2	41.3	903.5	46.9
18	(Cap. 50000t/y)	Fixed cost	453.1	27.0	461.2	28.6	458.7	28.3	467.0	28.2	614.7	35.1	609.7	31.6
19		R O I	295.3	17.6	295.3	18.3	295.3	18.2	315.0	19.0	410.6	23.4	410.6	21.3
20		Transfer price	1673.0	100.0	1612.3	100.0	1620.7	100.0	1651.4	100.0	1749.5	100.0	1923.8	100.0
21	MTBE	Variable cost	246.9	82.3	219.3	80.4	233.5	81.4	232.0	81.6	193.5	73.9	170.0	71.4
22	(Cap.100000t/y)	Fixed cost	30.3	10.1	30.7	11.2	30.6	10.6	29.6	10.4	38.6	14.7	38.4	16.1
23		R O I	22.7	7.5	22.7	8.3	22.7	7.9	22.7	7.9	29.5	11.2	29.5	12.4
24		Transfer price	299.9	100.0	272.7	100.0	286.8	100.0	284.3	100.0	261.6	100.0	237.9	100.0

Table III-2-21(3) Cost Comparison of Petrochemical Products (1986)

			Japan		U S A		W Europe		N I C S		SaudiArabia		Argentina	
	Product	Cost	$/t	%	$/t	%	$/t	%	$/t	%	$/t	%	$/t	%
1	METHANOL	Variable cost			67.0	101.8	82.0	35.0			14.8	6.6	15.2	6.8
2	(Cap. 50000t/y)	Fixed cost			86.2	39.3	86.1	36.8			116.6	52.6	116.3	52.5
3		R O I			65.8	30.0	65.8	28.1			90.0	40.6	90.0	40.6
4		Transfer price			219.0	100.0	233.9	100.0			221.4	100.0	221.5	100.0
5	AMMONIA	Variable cost	135.0	47.5	64.1	29.9	78.3	34.3	126.5	44.5	15.7	7.4	18.3	8.6
6	(Cap. 50000t/y)	Fixed cost	84.5	29.7	85.0	39.7	84.9	37.2	88.7	31.2	109.5	52.2	109.2	51.5
7		R O I	64.6	22.7	64.6	30.2	64.6	28.3	68.6	24.1	84.3	40.2	84.3	39.8
8		Transfer price	284.1	100.0	213.7	100.0	227.8	100.0	283.8	100.0	209.5	100.0	211.8	100.0
9	UREA	Variable cost	360.2	82.1	291.9	78.8	341.9	81.3	345.2	80.4	171.8	61.5	286.4	72.8
10	(Cap. 50000t/y)	Fixed cost	44.3	10.1	44.6	12.0	44.5	10.5	47.3	11.0	60.6	21.7	60.4	15.3
11		R O I	33.7	7.6	33.7	9.1	33.7	8.0	36.5	8.5	46.6	16.7	46.6	11.8
12		Transfer price	438.2	100.0	370.2	100.0	420.1	100.0	429.0	100.0	279.0	100.0	393.4	100.0
13	DMT	Variable cost	350.1	54.0	315.4	51.1	339.9	53.1	332.3	52.1	194.8	32.8	230.3	36.7
14	(Cap.100000t/y)	Fixed cost	171.1	26.4	174.3	28.2	173.3	27.0	172.3	27.0	226.1	38.1	224.1	35.8
15		R O I	126.5	19.5	126.5	20.5	126.5	19.7	132.1	20.7	171.5	28.9	171.5	27.4
16		Transfer price	647.7	100.0	616.2	100.0	639.7	100.0	636.7	100.0	592.4	100.0	625.9	100.0

Table III-2-22 Comparison of Production Costs: Standardized(Western Europe= 1.0)

		W Europe	Japan	U S A	Argentina	NICs	Saudi Arabia
Ethylene	Variable Cost	1.0	1.06	0.97	0.61	0.99	0.32
	Fixed Cost + R O I	1.0	1.00	0.83	1.13	1.07	1.41
	Production Cost	1.0	1.02	0.87	0.97	1.04	1.06
LLDPE	Variable Cost	1.0	1.06	0.84	0.87	1.00	0.50
	Fixed Cost + R O I	1.0	0.99	1.00	1.23	0.98	1.23
	Production Cost	1.0	1.03	0.90	1.00	0.99	0.77
HDPE	Variable Cost	1.0	1.05	0.85	0.85	0.99	0.50
	Fixed Cost + R O I	1.0	0.99	1.00	1.31	0.92	1.32
	Production Cost	1.0	1.02	0.92	1.06	1.02	0.88
PVC	Variable Cost	1.0	1.05	0.85	0.85	1.00	0.49
	Fixed Cost + R O I	1.0	0.99	1.00	1.34	1.05	1.35
	Production Cost	1.0	1.03	0.91	1.04	1.02	0.83
SM	Variable Cost	1.0	1.06	0.93	0.89	1.00	0.51
	Fixed Cost + R O I	1.0	1.00	1.00	1.35	1.04	1.35
	Production Cost	1.0	1.04	0.95	1.01	1.01	0.72
PP	Variable Cost	1.0	1.05	0.99	0.47	1.00	0.77
	Fixed Cost + R O I	1.0	1.00	1.00	1.28	0.98	1.28
	Production Cost	1.0	1.03	1.00	0.80	0.99	0.98
AN	Variable Cost	1.0	1.05	0.95	0.64	0.99	0.69
	Fixed Cost + R O I	1.0	1.00	1.00	1.35	1.05	1.35
	Production Cost	1.0	1.03	0.97	0.95	1.02	0.98
OL	Variable Cost	1.0	1.09	0.90	0.55	1.00	0.59
	Fixed Cost + R O I	1.0	0.99	1.00	1.34	1.02	1.34
	Production Cost	1.0	1.04	0.95	0.94	1.01	0.96
PS	Variable Cost	1.0	1.05	0.99	0.98	0.98	0.65
	Fixed Cost + R O I	1.0	0.98	1.01	1.27	0.98	1.29
	Production Cost	1.0	1.02	1.00	1.09	0.98	0.90
CPL	Variable Cost	1.0	1.09	0.94	0.97	1.01	0.72
	Fixed Cost + R O I	1.0	0.99	1.00	1.35	1.04	1.35
	Production Cost	1.0	1.05	0.96	1.13	1.02	0.99
ABS	Variable Cost	1.0	1.07	0.99	1.04	1.00	0.84
	Fixed Cost + R O I	1.0	0.99	1.00	1.35	1.04	1.36
	Production Cost	1.0	1.03	0.99	1.19	1.02	1.08
MTBE	Variable Cost	1.0	1.06	0.94	0.73	0.99	0.83
	Fixed Cost + R O I	1.0	0.99	1.00	1.27	0.98	1.28
	Production Cost	1.0	1.05	0.95	0.83	0.99	0.91
Methanol	Variable Cost	1.0	—	0.82	0.19	—	0.18
	Fixed Cost + R O I	1.0	—	1.00	1.36	—	1.36
	Production Cost	1.0	—	0.94	0.95	—	0.95
Ammonia	Variable Cost	1.0	1.72	0.82	0.23	1.62	0.20
	Fixed Cost + R O I	1.0	1.00	1.00	1.29	1.03	1.30
	Production Cost	1.0	1.25	0.94	0.92	1.25	0.92
Urea	Variable Cost	1.0	1.05	0.85	0.84	1.01	0.50
	Fixed Cost + R O I	1.0	1.00	1.00	1.37	1.07	1.37
	Production Cost	1.0	1.04	0.88	0.94	1.02	0.66

Source: Study Team

Mexico, Brazil, and Venezuela), Saudi Arabia and several Asian countries (Indonesia, Singapore, and Malaysia), and then introduce the outline of incentive policies in Saudi Arabia.

(1) Comparison of incentive policies in various countries

The major items of incentive policies are as follows:

- Basic right and guarantee for the interest of investors
- Protection of foreign invester's interest
- Tax reduction and exemption
- Other incentives

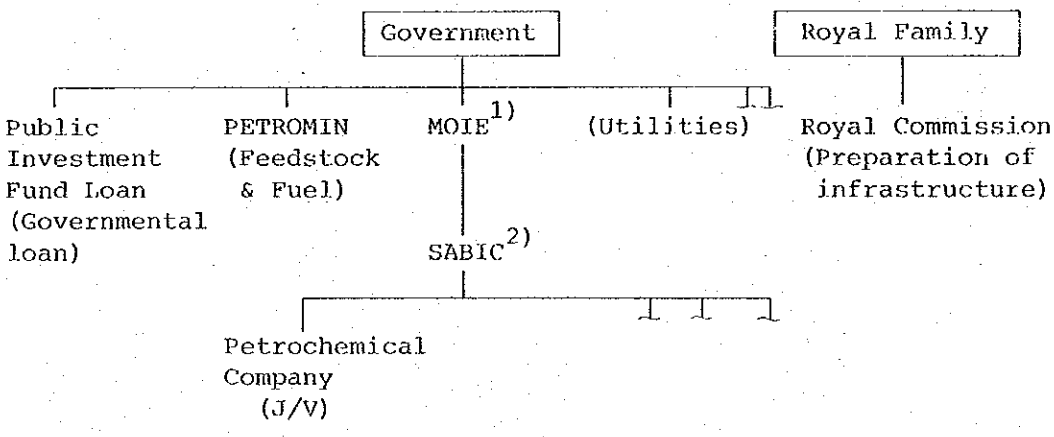
Table III-2-23 shows the measures of incentive policies in various countries. The incentive policies should be effectively introduced to develop industries having priorities to meet the national conditions. The whole systems of incentive policies are complexed in its legal aspect, and it is not easy to find out the details of incentive policies in other countries. Moreover, the incentive policies might be changed as the time being, reflecting the changes of country's economical situation.

The Argentine incentive policies can be examined, being compared with other countries. In appearance, there is not so large difference among Latin American countries. To develop the Argentine petrochemical industry, the incentive policies in other countries must be investigated precisely and the result of the investigation should be effectively introduced to meet the Argentine domestic situation.

(2) Outline of incentive policies in Saudi Arabia

The Saudi Arabian government has adopted the philosophy for improving added value to their hydrocarbon resources, and they realized big petrochemical projects, introducing favorable incentive policies. The outline of Saudi Arabian incentive policies are as follows.

1) Official organizations in relation to the petrochemical industry is shown below.



1) Ministry of Industry and Electricity
2) Saudi Arabian Basic Industry Corporation

Table III-2-23 Incentive for Industrial Developement Plan

I T E M S	Argentina	Brazil	Mexico	Venezuela	Saudi Arabia	Indonesia	Singapore	Malaysia	Thailand	REMARKS
1. Guarantee for the interest of investors										
1) Guarantee for expropriation						0	0	0	0	
2) Guarantee for nationalization					0	0	0	0	0	
3) Profit remittance	0	0	0	0	0	0	0	0	0	
2. Protection of foreigners' interest										
1) Employment of foreigners		0		0	0	0	0	0	0	
2) Right of license	0	0	0	0	0	0	0	0	0	
3) Favor for introducing governmental loan	0	0	0	0	0	-	0	0	0	
3. Tax reduction or exemption										
1) Capital gain tax						-	-	0	-	
2) Corporate income tax	0	0	0	0	0	0	0	0	0	
3) Tax for imported capital goods	0	0	0	0	0	0	-	0	0	
4) Tax for imported raw materials	0	0	0	0	0	0	0	0	0	
5) Tax for royalty	0		0		0	-	0	0	0	
6) Withholding for interest of foreign loan		0				-	0	0	0	
7) Acceleration of depreciation	0		0			0	0	0	0	
8) Carry over of losses	0		0	0	0	0	0	0	0	
4. Other incentives										
1) Preparation of infrastructure	0	0	0	0	0	0	0	0	0	
2) Raw materials price	0		0	0	0	0	-	0	0	
3) Utilities price	0				0					

Source: JETRO

2) Major incentives are following 7 items:

a) Preparation of infrastructure

The following infrastructures are prepared by the government and supplied in cheap price.

- Port & berth for shipping
- Road around the site
- Land preparation of the site
- Habitation for employee (50%)
- Utilities (Electricity, Sea water, Industrial water, Fuel gas)
- Raw material (Ethane)
- Sleepers for pipe-line

b) Tax holidays for corporate tax: 10 years after starting up

c) Grace period of governmental loans: 5 years after loaning

d) Loan condition

PIF Loan	60%
Capital	30%
Commercial Bank loan	10%

e) Exemption of tax and duty

- Exporting duty of products
- Importing duty of capital goods and raw materials
- Tax for royalty
- Personnel income tax including foreigner
- Tax for profit remittance

f) Deduction of corporate income

- Carry over of losses after tax holidays
- Accumulation of interest during construction after starting up

g) Other incentives

- Production cost is decided by 'Net Back System'
- Repatriation of foreign capital is not restricted

2-3 Recent Trends and Future Prospects of Argentine Petrochemical Industry

Based on the evaluation for international market situation of petrochemicals in the previous section, analyses for current and future prospects of Argentine petrochemical industry are described in this section.

2-3-1 Present Situation and Problems

(1) Introduction

Petrochemical industry in Argentina started in early 1940s by Yacimientos Petroliferos Fiscales (YPF) in San Lorenzo for the production of isopropanol from the refinery off-gas and also by Direccion General de Fabricaciones Militares (DGFM) in Campana for the production of aromatics by naphtha reforming process, both of which were the first petrochemical establishments in the Latin America region.

However, because of small market size, lack of industrialization to use petrochemical product and unstable economic policy, there had not been notable large amount of investment in petrochemical sector until the construction plan of petrochemical complex in Bahia Blanca. In the complex, the company of producing ethylene named Petroquimica Bahia Blanca started operation in 1981.

Nowadays, major petrochemical plants are concentrated in three center locations with major core complex as follows (see Appendix 2-A-1).

Location	Core	Product
- Bahia Blanca	Petroquimica Bahia Blanca SA (PBB)	Ethylene
- Ensenada	Petroquimica General Mosconi (PGM)	Aromatics
- Santa Fe	Petroquimica Argentina SA (PASA)	Aromatics

Recent trend of petrochemical industry is shown in Table III-2-24. As shown in the Table, recently there has been remarkable increase of production and demand for ethylene and polyethylene. That is due to the completion of plant of Petroquimica Bahia Blanca (200,000 tons/year).

Other products such as ethylene glycol, polypropylene oxide showed high rate of increase of demand. However it should be noted that generally demand volume of these products were too small to justify the domestic production because the plant size can not attain the economy of scale.

Table III-2-24 Recent Trends of Supply and Demand for Major Petrochemical Products

(1,000 tons/year, %/year)

Product	1980					1982					1984					Annual growth rate(80-84)	
	Capacity	Production	Import	Export	Demand	Capacity	Production	Import	Export	Demand	Capacity	Production	Import	Export	Demand	Production	Demand
Ethylene	54	50.6			50.6	254	180.2		20	160.2	254	257		46	211	50.1	42.9
LDPE	35	30.8	38		68.8	225	136.7	9	23	122.7	225	136.5	1	57.8	102.4	45.1	10.5
HDPE			23		22.6			25		25.3	88.5	21.6	23.3	6.4	38.5		14.2
EG			3		2.9			5		5			7.9		7.9		28.5
SM	54	48.3		13	35.3	54	48.1		9	39.1	54	57.1	1	6	52	4.3	10.2
PVC	n.a.	34.1	20	1	53.1	n.a.	46.5	7		53.5	59	53.6	15.6	0.1	69.1	12	6.8
PS	51.2	22	3		25	51.2	22.4	1		23.4	47.9	29.3	3.1	0.9	31.5	7.4	5.9
SBR	50	33	3	5	31	50	45.6	3	18	30.6	50	46	0.6	13.7	32.9	8.7	1.5
ABS&SAN	n.a.	4.2	1		5.2	n.a.	2.9	1		3.9	11	7.7			7.7	16.4	10.3
PP			18.6		18.6			23.3		23.3			32.5		32.5		15
PO			0.4		0.4			1.1		1.1			3.2		3.2		68.2
PG			6.6		6.6			6.1		6.1			6		6		-2.4
AN			9.8		9.8			15		15			13.5		13.5		8.3
IPA	35	20		5	15	35	32		16	16	35	32.4		17	15.4	12.8	0.7
Benzene	144	156.7		67	89.7	144	159.2		68	91.2	144	169.5		59.6	109.9	2	5.2
Nylon 6	14.7	4.9	1.3		6.2	14.7	1.9	n.a.	n.a.		22.6	5	0.6		5.6	0.5	-2.5
Nylon 66	21.6	14.2			14.2	21.6	14.1			14.1	21.6	18.4			18.4	6.7	6.7
DMT			2		2			6.4		6.4			7.2		7.2		37.7
AB	40	32.2	2.8	14.5	20.5	40	26.7	0.1	9.2	17.6	40	n.a.	0.2	9.2	n.a.		
Butadiene	33	27.8		5.8	22	33	33.9		6.7	27.2	33	28			28	0.2	6.2
Methanol	34	33	5.6	3.1	35.5	34	33.5	0.5	4.7	29.3	34	31.3	3	0.6	33.7	-1.3	-1.3
Ammonia	87.6	64.3		0.5	63.8	87.6	78.5		0.5	78	87.6	70	2.7	0.2	72.6	2.1	3.3
Urea	n.a.	59.3	36.9	0.2	96	79.5	n.a.	n.a.	1.5	86.5	99	87	86	0.5	172.5	10.1	15.8
Acetic Acid	14.9	8.2	1.8		9.2	14.9	11.3			11.3	14.9	13.1			13.1	12.4	9.2

Source: Anuario Petroquimico Latinoamericano 1985.

Table III-2-25 Prices of Raw Materials and Energy in Argentina (as of June 1986)

(Exchange Rate: US$1=A0.84)
(Delivered Price)

Products	Unit	Official Sales Price	Retention Value	Remarks
Naphtha	$/T	95.0	177.9	
Gas oil	$/T	99.9	153.1	
Kerosene	$/T	105.6	161.5	
Fuel oil	$/T	55.8	79.5	
Refinery gas	$/$10^6$ kcal	5.73	7.57	
Natural gas				9300kcal/m³
Buenos Aires	$/m³	0.0538	0.0704	
Campana	$/m³	0.0519	0.0704	
Rio III	$/m³	0.0401	0.0619	
Pilar	$/m³	0.0529	0.0704	
Bahia Blanca	$/m³	0.0388	0.0619	
P. B. B.	$/m³	0.0185	0.0619	Priority Project
San Lorenzo	$/m³	0.0798	——	For Existing Plants
Natural gas Ethane				
Buenos Aires	$/T	104.4	133.6	
Bahia Blanca	$/T	85.2	122.4	
P. B. B.	$/T	70.1	122.4	Priority Project
Neuquen	$/T	65.6	95.1	
Propane•Butane				
Buenos Aires	$/T	87.6	116.1	
Campo Duran	$/T	73.2	116.1	
San Lorenzo	$/T	80.0	116.1	
Propylene•Butylene	$/T	96.6	133.5	From FCC
Crude oil				
Mendoza	$/BBL	11.9	——	API 31-31.9
Neuquen	$/BBL	13.2	——	〃
Tierra del Fuego	$/BBL	13.4	——	API 40-40.9
Salta	$/BBL	13.5	——	API 57-57.9

Source: YPF, GDE, PGM and others
Note : Official Sales Price means the sales price to petrochemical companies. Retention value is the value paid to raw material supplier.

(2) Enterprises in petrochemical industry

Petrochemical companies in Argentina are illustrated in Appendix. Capital relationships of petrochemical companies and institutions are rather complexed but generally are classified into the following three categories:

- Public organizations:
  Petroquimica General Mosconi (PGM), Petroquimica Bahia Blanca (PBB), ATANOR, Petroquimica Rio Tercero (P.R.III), Direccion General de Fabricaciones Militares (DGFM)

- Foreign investor's organizations:
  BASF, CASCO, DUCILO, DUPERIAL, MONSANTO, INDUQUIM, PASA

- Domestic organizations:
  HISISA, INDUPA, MALEIC, Petroquimica CUYO, IPAKO

The enterprises in these three categories tend to pursue different direction depending on their background. Also, the interests of the National Petroleum Corporation (YPF), the National Gas Corporation (GDE), and resource-rich provinces (Neuquen, etc.) are entangled with each other in a complex manner. Thus, the development of petrochemical industry requires the overall coordination by the government.

(3) Pricing policies for raw materials and energy

Table III-2-25 shows the prices of raw materials and energy in Argentina. The prices of raw materials, energy, and petrochemical products have been determined by the government. But, the raw material price does not reflect the production cost. The price depends on the project priority, and there is a large difference in prices among different projects.

(4) Export and import policies

According to Mercado, April 24, 1986, the petrochemical industry is ranked third in 1985 among the mining and manufacturing sector of the country in terms of export amount, following petroleum and steel industries. In the first fifty exporting companies, there are eleven petrochemical companies. Among them, PGM (Export amount; US$69 million), PASA (US$50 million) POLISUR (US$28 million) are top companies.

Despite the delay in modernization of the existing plant and small size of the plant, the petrochemical companies in Argentina have, seemingly, been making a considerable profit, supported by import duty.

It is a logical outcome that present taxation system for external trade makes the petrochemical enterprises concentrate on the supply of their products to the protected domestic market, while hardly giving them any incentives for actively porticipating in export market. This is one of the principal reasons why they are reluctant for the new construction of a large scale export oriented plant. Therefore it

is desirable that export duty is completely exempted in order to promote exports of petrochemical products. Also, gradual abolition of import duty is recommendable to make the petrochemical industry competitive.

Table III-2-26 shows the import duty, the domestic and export prices of major petrochemical products.

Table III-2-26 Import Duty, Domestic Price (Delivered) and Export Price of Major Petrochemical Products (as of June 1986)

Products	Import Duty (%)	Domestic Price (US$/ton)	Export Price (FOB; US$/ton)
Ethylene	25	422	250
LDPE	14 - 38	1,100	600
HDPE	25	1,000	600
PVC	38	1,000	500
SM	90	585	
SBR	38	739 - 885	
ABS	10	1,200	1,200

Source: Prices; P.B.B., INDUPA, PASA and others
Import duty; Guia Practica del Exportador e Importador, Abril 1986

Notes: 1) Import duty for SM is consisted of direct duty (50%) and additional duty. This additional duty will be 40% by Sept. 1988, 30% from Oct., 1988 to Sept., 1989 and 15% from Oct., 1989 to Sept., 1990.
2) Import duties and taxes are calculated from the following equation and total amount without import duty will reach 15% additionally.

Import duties and Taxes =
Import duty (CIF x 10 - 48%) + Statistic tax (CIF x 3%) + Fund for promotion of ships (FOB x 12%) + Fund for promotion of export (CIF x 0.5%) + Consular Fee (Invoice x 2%)

(5) Advantage and disadvantages of Argentine petrochemical industry

1) Cheap prices of raw materials and energy

Table III-2-27 shows the comparison of the current prices with those in Japan. The prices of raw materials in Argentina are much cheaper than that of Japan, so the variable cost is very low. The difference, however, is getting smaller, because of a recent sharp reductions in oil price.

Table III-2-27 Comparison of Prices between Argentina and Japan

	Unit	Argentina (A0.84/$)	Japan (¥160/$)	Price Ratio (Argentina/Japan)
Crude Oil	US$/BBL	11.9 - 13.5	10 - 13	0.92 - 1.35
Naphtha	US$/T	95	150	0.63
Ethane	US$/T	65.6 - 104.4	130	0.51 - 0.80
LPG (Propane)	US$/T	73.2 - 87.6	250	0.29 - 0.35
LPG (Butane)	US$/T	73.2 - 87.6	220	0.33 - 0.40
Fuel Gas	US$/$10^6$ kcal	1.98 - 8.58	11.5	0.17 - 0.75

Source: YPF, PGM, PBB, Study Team and others

2) High investment cost

The technologies of petrochemical plants are introduced from overseas, and the license and basic design are carried out by the foreign process owner. Except for special equipment, the total amount of domestic portion of plant construction is guided to be 80%, so the field work and manufacturing of common equipment are carried out by Argentines. However, since the equipment for petrochemical plants require high level of technology, the imported portion tends to be high. Also, as a result of delay of construction due to the delayed delivery of equipment manufactured in Argentina and improper financing plan, construction cost seems to be 20 to 50% higher than that of U.S. Gulf coast. In addition, high interest makes the fixed cost higher.

3) High export freight

Argentina is located far from large consumption areas such as North America, Western Europe, and Southeast Asia. Thus, the rate of freight is high. The freight of a typical export product (low-density polyethylene) is shown below.

Argentina to Japan: US$170/ton (FOB; US$600/ton)
Brazil to Japan : US$100/ton
Argentina to USA : US$ 70/ton
Argentina to Western Europe: US$70 - 80/ton

In the case of export for Southeast Asia area, the freight is about 30% of the export price (FOB) and for North America and Western Europe, it occupies 12 to 13%. Thus, the freight is a handicap for competition in the export market.

As stated above, the advantage of Argentine petrochemical industry is a low variable cost. The disadvantages are a high fixed cost and high freight for export. Therefore it is reasonable firstly to fill the domestic demand with the rational price and secondly to export utilizing surplus capacity, namely 10 to 15% of the total capacity.

(6) Evaluation of the existing complex

Outline of following three complexes are illustrated in Table III-2-28.

(a) Bahia Blanca complex

The Bahia Blanca complex is located in Bahia Blanca about 800 km south of Buenos Aires. There exists a relay terminal of natural gas pipelines. With the annual production capacities of ethylene (200,000 tons), LDPE (70,000 tons), and LLDPE (120,000 tons), it is regarded as the only complex having internationally competitive scale in Argentina. However, it has not developed its full potentials, because of delay of plant construction for HDPE, VCM, and PVC. The supply capacity of raw material, ethane, is limited to 285,000 tons per year (t/y) (235,000 t/y in ethylene) having bottlenecks in the pipeline and extraction facilities. The complex, when completed of all the down-stream projects, will require the ethylene production capacity of about 330,000 t/y, which in turn will require a huge amount of investment for the new pipeline, ethane extraction unit, and ethylene plant.

Flexible actions are therefore necessary in the case of completion of downstream projects, such as expanding and modifying to increase capacity in the existing plants by debottlenecking, putting the priority for the projects of ethylene derivatives, and importing and exporting some products including ethylene. In our visit to the site, we could observe the construction of the plants for HDPE, VCM, and PVC by INDUPA group, and the expanding capacity of ethylene (from 200,000 to 245,000 t/y) of PBB were in smooth advance. It seemed that they would complete in 1986. When all the plants, under construction, are completed, ethylene demand will be 265,000 t/y and ethylene capacity will be 245,000 t/y. Insufficient ethylene is going to be imported, using the existing ethylene export facilities.

Table III-2-28 (1) Outline of Bahia Blanca Complex

(1,000 tons/year)

Products	Company	Existing plants		Under construction		Future projects		Ownership
		Capacity	as Ethylene	Capacity	as Ethylene	Capacity	as Ethylene	
Ethane	GAS DEL ESTADO (GDE)	285	235			160	120	State:100%
Ethylene	Petroquimica Bahia Blanca (PBB)	200	200	(Revamp)45	45	120	120	State:51% Private:49%
LDPE	POLISUR	70	80					State(DGFM):30% Private(IPAKO):70%
LLDPE/HDPE	POLISUR	120	120					
HDPE	PETROPOL			62	64.5			State(DGFM):30% Private(INDUPA):70%
VCM	Monomeros Vinilicos			130	32			State(DGFM):30% Private:70% (ELECTROCLOR,INDUPA)
PVC	INDUPA			56				Argentine private group:100%
PVC	ELECTROCLOR					41.5	33.5	DUPERIAL:30% Celurosa Arg.SA:30% Private:40%
Ethylene Balance								
Supply (Total)			200		245		365	
Demand (Total)			200		296.5		330	
Balance (Total)			0		-51.5 (Import)		35 (Export)	

Source: Anuario Petroquimico Latinoamericano 1985 and others

Table III-2-28 (2) Outline of Santa Fe Complex

(1,000 tons/year)

Products	Company	Production capacity			Ownership	Raw materials
		Existing	Future projects	Total		
Ethylene	DUPERIAL	15	(Revamp)7	22	Imperial Chemical;100%	Naphtha
Carbon bisulfide	DUPERIAL	14		14		Natural gas. Sulfur
Phthalic Anhydride	DUPERIAL	14		14		o-Xylene
LDPE	DUPERIAL	20		20		Ethylene
Plasticizers	DUPERIAL	18		18		
Propylene & Butadiene	DUPERIAL	6	(Revamp)3	9		Naphtha
Aromatics	DUPERIAL	13	(Revamp)6	19		Naphtha
Ethylene	PASA	23		23	Amocorp;25%	Naphtha,Propane
Aromatics	PASA	150		150	Vista Chemical; 25%	Naptha
Butadiene	PASA	37		37	Uniroyal; 25%	Butane
Ethylbenzene	PASA	65	(Revamp)5	70	Witico Chemical;13.5%	Ethylene,Benzene
SM	PASA	54	(Revamp)11	65	Fish Inter America;11.5%	Ethylbenzene
SBR	PASA	54		54		SM,Butadiene
Nitrile Rubber	PASA	2		2		AN,Butadiene
SBR	INDOQUIM	5		5	Dow Chemical;100%	SM,Butadiene
Topper(BD)	YPF	33,000		33,000	State;100%	Crude Oil
Thermal Cracker (BD)	YPF	4,000		4,000		
Visbreker (BD)	YPF	12,000		12,000		

Source: Anuario Petroquimico Latinoamericano 1985 and others

Table III-2-28 (3) Outline of Ensenada Complex

(1,000 tons/year)

Products	Company	Production capacity			Ownership	Raw materials
		Existing	Future projects	Total		
Benzene	PGM	67		67	YPF:50%	Straight run Naptha
Toluene	PGM	38		38	DGFM:50%	(Reforming)
o-Xylene	PGM	23		23		
p-Xylene	PGM	32		32		
mix-Xylene	PGM	9		9		
Cyclohexane	PGM	33		33		Benzene,Hydrogen
Gasoline Hydrogenation	PGM	25		25		
Oxoalcohol	PGM	0	35	35		Propylene
MTBE	PGM		40	40		iso-Butylene,Methano
Butene-1	PGM		25	25		Butane,Butylenes
DMT	PGM		45	45		p-Xylene,Methanol
PET	PGM		17	17		DMT,EG
Ethylene	IPAKO	15		15	Private:100%	Refinery products
LDPE	IPAKO	14		14		Ethylene
Propylene	YPF	61.5	30	91.5	State:100%	FCC off gas
Butylene	YPF	6.1	3	9.1		FCC off gas
Oligomers	YPF	19		19		Propylene
Alkylbenzene	YPF	40		40		Oligomers,Benzene
Topper (BD)	YPF	230,000		230,000		Crude Oil
FCC (BD)	YPF	41,000	19,000	60,000		
Reformer (BD)	YPF	9,000		9,000		
Coker (BD)	YPF	23,000		23,000		
Alkylation(BD)	YPF	3,000		3,000		

Source: Anuario Petroquimico Latinoamericano 1985 and others

(b) Santa Fe complex

The Santa Fe complex is located about 300 km northwest of Buenos Aires. There exists a relay terminal of natural gas pipeline. The complex is producing ethylene and ethylene derivatives, such as LDPE (20,000 t/y), SM (54,000 t/y), and SBR (54,000 t/y), consuming ethylene from small-scale plants of PASA (23,000 t/y) and of DUPERIAL (15,000 t/y). Almost all the products are transported by trucks to small consumers in Buenos Aires, the biggest market.

In this complex, SM capacity is being expanded from 54,000 to 65,000 t/y by PASA, and ethylene capacity is being expanded from 15,000 to 22,000 t/y by DUPERIAL. Santa Fe is far away from the raw-material production areas (Neuquen, Mendoza, Salta, and Tierra del Fuego) and from consumption area (Buenos Aires) and the means of transportation of products is depending on trucks. Thus, Santa Fe has some disadvantages as a candidate for large-scale of new projects.

(c) Ensenada complex

The Ensenada complex is located about 70 km southeast of Buenos Aires. With YPF having the refining capacity of about 230,000 barrel per day as a center of this complex, this complex has a capacities of a small-scale ethylene (15,000 t/y) and LDPE (14,000 t/y) owned by IPAKO, and aromatics (benzene 67,000 t/y, cyclohexane 33,000 t/y) by PGM.

The PGM company, another center of this complex, is now proceeding with the planning for oxoalcohol (35,000 t/y), MTBE (40,000 t/y), and butene-1 (25,000 t/y). The major raw materials for this projects are propylene and butylenes, which are planned to be recovered from the off-gas from FCC (capacity 41,000 barrel/day) of YPF company. The planning is economically reasonable because of utilizing cheap raw materials from refinery. The PGM company is also examining new projects of DMT (45,000 t/y) and PET (17,000 t/y) as the second phase. Ensenada is close to the largest market, Buenos Aires, and having harbors for export. Therefore, with the integration of YPF and PGM, it seems feasible to realize new projects, utilizing aromatics, of C_3 and C_4 derivatives as the major products, also considering the possibility for export.

2-3-2 Forecasts for Demand and Supply of Major Petrochemical Products

(1) Outline of the method for demand forecasting

There are two kinds of forecasting method of petrochemical products namely,

a) Summing up of individual demand method

b) International referential method

These two methods have following characteristics.

(a) Summing up of individual demand method

This method follows steps mentioned below.

1) Forecast of demand of final product according to the each demand sector such as housing, home electric appliances and automobile. (e.g. number of production of automobile)

2) Forecast of volume of petrochemical products used for the production of above mentioned final products.
(e.g. current consumption amount of PVC for the production of automobile)

3) Forecast of change of consumption pattern of petrochemical products reflecting the substitution among them.
(e.g. increase of consumption amount of PVC for the lighter automobile)

4) Sum up of all demand items

In order to perform this method properly, quite detailed statistics and forecast of each demand side industry are necessary. In Argentina, however, enough information are not available to follow those procedures.

(b) International referential method

In this method, forecast of demand is performed by utilizing the different country's correlation between GNP per capita and consumption of petrochemical products per capita.

In this method, petrochemical products are classified into several groups and demand forecast is done according to those groups. Within the group, the demand forecast of each individual petrochemical products is performed by breaking down the group demand to individual product.

This method is useful when basic statistics such as GNP, population are available although detailed ones are not existing. In this report the latter method is employed.

(2) Steps of forecasting procedure

Study on utilization pattern of petrochemical products in Argentina

Products of large domestic demand are selected as study items. Those products are:
LDPE, HDPE, PVC, PP, PS, ABS,
EG, AN SBR, E, SM.

Study on selected countries for comparison

Mexico, Brazil, Japan, U.S.A. and Canada are selected.

Grouping of petrochemical products according to usage

Plastics for general purpose ..... LDPE, HDPE, PVC, PP
Plastics for industrial purpose ... PS, ABS
Petrochemicals for synthetic fibre ..... EG, AN
Petrochemicals for rubber ..... SBR

Calculation of demand of a group of products by country and year and calculation of GNP per capita

(Example) Plastic for general purpose

(kg per head)

Country \ Year	1976	1978	1980	1982	1983
Canada	24.4	28.9	33.4	28.4	36.7
U.S.A.	30.8	37.5	36.2	35.7	41.2
Mexico	4.0	5.3	7.7	7.7	8.0
Brazil	5.3	5.5	7.6	6.6	6.5
Japan	22.3	27.8	33.2	30.5	33.3
Argentina	3.9	4.8	5.9	7.9	7.5

Regression by a group of product and year

LOG (Plastics for general purpose/population)
= a x LOG(GNP/Population) + b

(Figure III-2-5)

Analysis of regression obtained

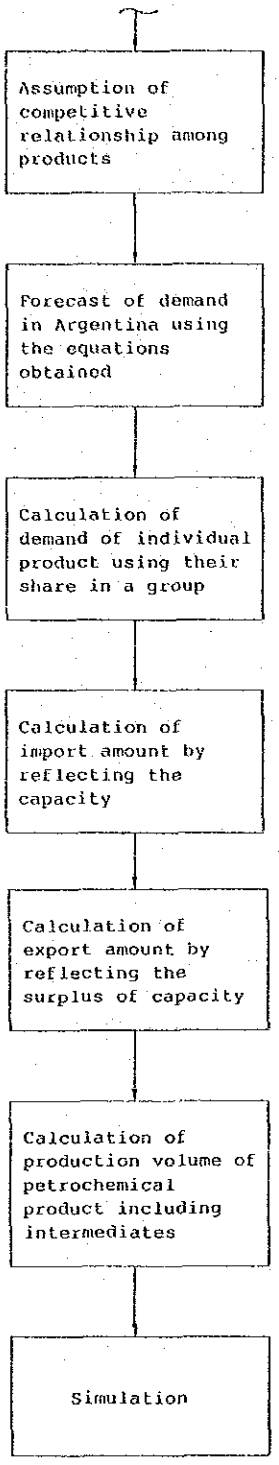
Evaluation of correlation coefficient, t-value and coefficient. Regression has been done for the years of 1976, 1978, 1980, 1982 and 1983. No major difference is found among these years and hence the most current data of 1983 is employed.

Assumption of the growth rate of GNP in Argentina

Three cases of GNP increase are assumed, namely, 2%, 4% and 6% per annum.

Assumption of the increase of production capacity based on the recent investment plans

Based on the field study, the most realizable plans are included in the increase of production capacity.



Within a group, the change of share of each product is introduced.

(Example) HDPE erodes LDPE's share by 0.2 points a year. The same as for PP and PVC, PS and ABS, EG and AN.

By assuming the figure of GNP per capita, forecast of demand can be obtained.

If production capacity is enough to satisfy the domestic demand, it is assumed that current import is going to be substituted by domestic product.

If surplus of capacity exists, it is assumed that export will increase gradually up to the operating rate of 90%.

After the calculation of production of each product, the production volume of intermediates is determined.

(Input ratio is shown in Table III-2-29)

Calculation according to following three cases:

	Increase rate of GNP per annum	Increase rate of population per annum
Case A	2%	2%
Case B	4%	2%
Case C	6%	2%

Calculation of domestic demand, production, export and import amount from 1985 to 1990.

Figure III-2-5 Correlation Between Plastic Consumption and Income

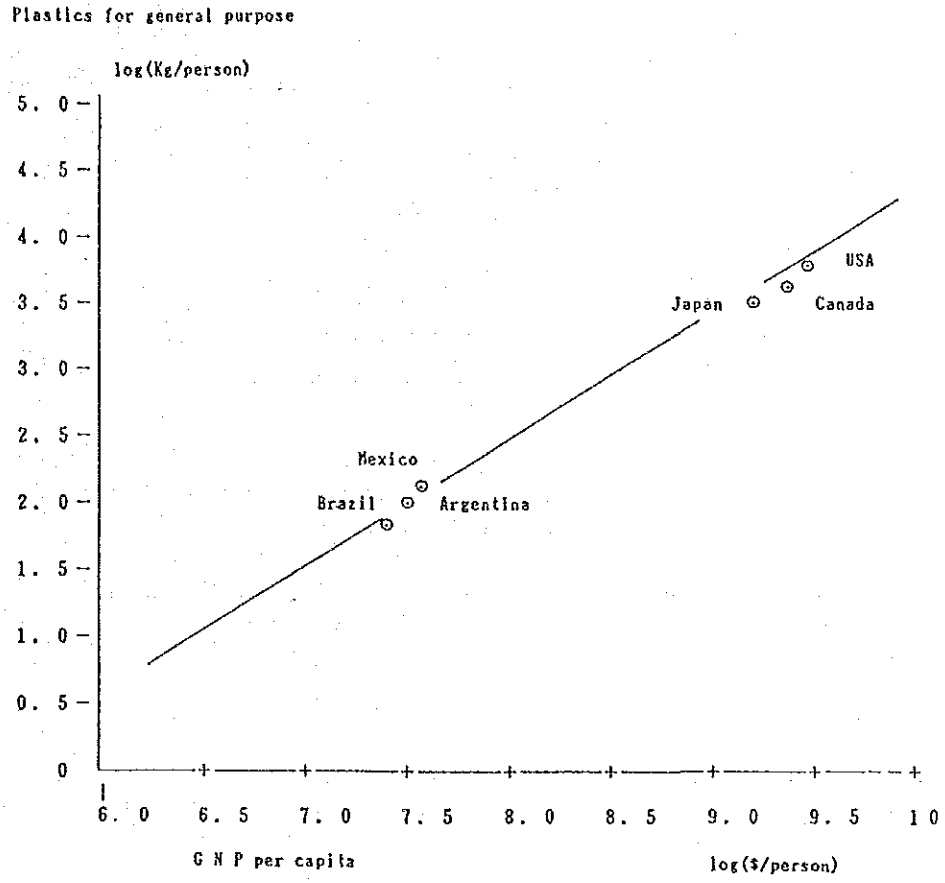


Table III-2-29 Unit Consumption of Intermediates

Products	Unit Consumption	Intermediates
PS	1.02	Styrene Monomer (SM)
ABS	0.40	
SBR	0.30	
LDPE	1.02	Ethylene (E)
HDPE	1.02	
PVC	0.50	
EG	0.66	
SM	0.28	
PP	1.02	Propylene (P)
AN	1.06	
IPA	0.75	
SM	0.82	Benzene (B)
Cyclohexane	0.93	
E	1.25	Ethane

(3) Assumptions and results of forecast

(a) Assumptions

1) From 1985 to 1995, the following annual growth rates are assumed.

		Case A	Case B	Case C
GNP	(%)	2.0	4.0	6.0
Population	(%)	2.0	2.0	2.0

2) In each case, correlation curves, calculated through regression equation, between GNP per capita and consumption per capita are also applicable for Argentine petrochemicals.

3) Plant capacity is generally based on the figure in June 1986, but some expanding capacity, which can be considered to be realized as a result of the field work, is also included.

4) Import

- Petrochemical products which are not produced domestically in June 1986: Import will continue, unless new plants of the products start.

- Petrochemical products which are produced domestically: Import will be introduced, unless there is enough production capacity to satisfy domestic demand.

5) Export

Petrochemical products can be exported up to the level of 90% plant utilization, if there is surplus capacity after 1991. Export volume from 1985 to 1990 are regarded as gradual change. Export volume will be reduced as a result of increasing domestic demand.

6) Internal competition in each group

- HDPE can be expected to alternate LDPE to some extent in the field, of film. Thus, HDPE will erode the share of LDPE.

- PP will alternate in the field of hard PVC.

- Growth rate of EG will be higher than that of AN.

- Growth rate of PS will be higher than that of ABS.

Table III-2-30 Domestic Demand

(1,000 tons, %)

	Case A				Case B				Case C			
	1985	1990	1995	1995/1985	1985	1990	1995	1995/1985	1985	1990	1995	1995/1985
LDPE	104	112	121	1.5	108	127	150	3.3	112	144	185	5.1
HDPE	31	37	44	3.4	32	42	54	5.3	33	47	67	7.2
PVC	74	79	84	1.3	77	90	105	3.1	79	101	129	4.9
EG	7	8	9	2.7	7	9	11	4.7	7	10	14	6.7
PS	26	29	32	2.2	27	34	43	4.6	32	44	60	6.4
ABS	6	6	6	0.7	6	7	8	3.1	8	10	13	4.4
SBR	33	37	41	2.0	34	41	49	3.6	36	46	60	5.3
PP	30	36	42	3.5	31	40	52	5.3	32	46	64	7.2
AN	18	20	21	1.7	19	22	27	3.6	19	26	34	5.6
IPA	16	17	19	1.9	16	20	24	4.0	16	22	29	6.0
SM	38	42	49	2.6	44	55	69	4.5	45	63	71	4.7
E	148	184	208	3.4	155	215	265	5.5	166	250	328	7.0
P	7	49	57	23.4	7	57	61	24.1	7	59	67	25.3
B	60	64	70	1.5	66	75	86	2.6	67	77	87	2.6

Notes: 1) The figure for SM, E, P, and B are corresponding to domestic production of their derivatives.
2) Column of 1995/1985 shows annual increase rate.

(b) Results

Details of results are shown in Appendix 2-A-2. Table III-2-30 is a summary of the results. In Table III-2-31 comparison with the SRI is made.

As shown in Table III-2-31 the predicted figures are higher in SRI than in ours. This is because the SRI prediction is the cumulative results of hearing from Argentine petrochemical industries in 1984. Usually producers' figures tend to be higher reflecting their desire. Meanwhile our figures are obtained by simple quantitative method.

As already stated, the growth rate of GNP greatly affects the medium- and long-term prediction for petrochemical demand. Therefore, it seems reasonable to carry out a case study using the rate values changing in some range, rather than using the rate represented by a single value. Thus, we have carried out the case study for GNP annual growth rate of 2%, 4%, and 6%. To judge which case is more realistic, authority in Argentina should pay attention to economical indicators such as the GNP growth rate as the target value of economic development, while observing the actual GNP growth rate in the future.

Table III-2-31 Comparison of Demand Forecasts

(1,000 tons, %/year)

	S R I		Team Forecasts					
			CASE-A		CASE-B		CASE-C	
	Demand in 1994	Growth Rate 1994/1984	Demand in 1994	Growth Rate 1994/1984	Demand in 1994	Growth Rate 1994/1984	Demand in 1994	Growth Rate 1994/1984
E	435	7.5	318.9	4.2	321	4.3	326.5	4.5
LDPE	228	8.3	119.1	1.5	145	3.5	175.9	5.6
HDPE	80	7.6	42.1	0.9	51.2	2.9	68.1	5.9
PVC	164	9.0	83.3	1.9	101.4	3.9	123	5.9
EG	15	6.6	8.7	1.0	10.7	3.1	13.2	5.3
SM	94	6.1	63.1	2.0	66.5	2.5	70.3	3.1
PS	59	6.5	31.4	0	45.7	3.8	56.5	6.0
PP	65	7.2	40.8	2.3	49.7	4.3	60.2	6.4
AN	34	9.7	20.9	4.5	25.8	6.7	31.8	8.9
ABS	12	4.5	5.9	- 2.6	9.7	2.3	11.9	4.4
SBR	49	4.1	39.7	1.9	47.6	3.8	56.9	5.6

2-3-3 Future Prospects

(1) Potentiality from the viewpoint of cost competitiveness

(a) Variable cost

As already stated, the Argentine petrochemical industry has advantages in its low cost of raw material and energy that makes the variable cost very low. When compared to Western Europe, the variable cost of Argentina is 85 to 90% in ethylene derivatives, 50 to 70% in propylene derivatives, and about 20% in natural gas derivatives. This estimation, however, is based on the incentive prices for new priority projects, and the prices of propylene and butylenes are also based on the assumption that they are recovered from refineries. Since aromatics are exported with the international prices, its domestic derivatives cannot have the advantage in variable cost.

(b) Fixed cost

The fixed cost in Argentina, due to high investment cost, is generally about 30% higher than that of Western Europe. The fixed cost seems 50% higher, when the high cost of fund is considered. The further effort will be needed to reduce investment cost.

(c) Total production cost

As a result of the preliminary comparison in total production cost with Western Europe the following products are superior to those in Western Europe:

Ethylene:	3% cheaper
Polypropylene:	20% cheaper
Acrylonitrile:	5% cheaper
Octanol:	6% cheaper
MTBE:	17% cheaper
Methanol:	5% cheaper
Ammonia:	8% cheaper
Urea:	6% cheaper

In general, a product, when its total production cost is cheap enough in Argentina, has a low variable cost and low ratio of fixed cost to total production cost.

(d) Evaluation of potentiality in Argentine petrochemical industry

In summary, the potentiality for new projects in Argentine petrochemical industry seems to exist in propylene and natural gas derivatives, or products in which the fixed cost occupies only a little, so that the cheap prices of raw material and energy can be fully advantageous. From the viewpoint of the products of which fixed cost occupies small portion, it is reasonable to reduce the investment cost and fixed cost per product by means of revamping of the existing plants. In these cases very small scale and old plants must be excluded from revamping.

(2) Evaluation of new projects

It is reasonable for public and private sectors to improve the foreign trade balance by alternating the current import products with domestic production. At present, the following products are not produced in Argentina and are the subjects to be studies from now on.

High-density polyethylene (HDPE)*
Ethylene oxide (EO) and Ethylene glycol (EG)
Ethylene dichloride (EDC)*
Polypropylene (PP)*
Propylene oxide (PO) and Propylene glycol (PG)
Acrylonitrile (AN)
Oxoalcohol*, n-Butanol, and Octanol
Acrylic acid (AA), Acrylic ester (AE)
Adipic acid
Caprolactam (CPL)
Telephthalic acid (TPA), PET resin*
Polybutadiene rubber
Polychloroprene rubber
Butyl rubber
MTBE*

(The projects marked with * are now in progress.)

As Table III-2-32 shows, there are many projects are announced in Argentina. Among them some prospective projects are selected and discussed as below.

(a) Development plan in Bahia Blanca complex

1) Expansion and modification of ethylene capacity

Expansion and modification of ethylene capacity by debottlenecking of the existing plant is suggested as the most feasible project.

In the new ethylene projects (120,000 t/y), the bottleneck exists in procurement of raw material ethane. This project requires pipeline and separation unit for natural gas ethane, and it takes a long period of construction and a huge amount of investment. Moreover, design capacity of 120,000 t/y of the second phase can not enjoy the economy of scale as they do in the plant of 200,000 t/y. Also, with ethane as the raw material, the products are limited to ethylene and its derivatives. The target should be overall development plan aiming at the well-balanced complex, including introduction of other raw materials such as propane, butane, and naphtha.

2) New plants by INDUPA group

The construction programs for electrolysis (NaOH, Cl_2), EDC, VCM, PVC, and HDPE are now in smooth advance, toward completion at the end of 1986. If all plants by INDUPA group are operating in addition to the existing LDPE and LLDPE plants, the supply of ethylene will be short, even after the PBB ethylene capacity is expanded.

Table III-2-32 Petrochemical Projects in Argentina

(tons/year)

COMPANY	LOCATION	PRODUCTS	CAPACITY (1,000 T/Y)	RAW MATERIALS	START UP	REMARKS Investment Cost(10^6 US$)
1. COLPET S.A.	(1) Ensenada, B.A.	(1) PET	② 10 ③ 17	DMT, EG	n.a.	18
2. DUPERIAL S.A.I.C.	(1) San Lorenzo, St. Fe	(1) Ethylene	+ 7	Naphtha	'88	
		(2) Phthalic Anhydride	+ 4.5	o-Xylene	n.a.	4
		(3) Butyl Rubber	① 12	Butylene	① 01/'88	① 25
		(4) Butadiene Rubber	① 26	Butadiene	① 07/'88	① 45
		(5) SBR	① 32	SM, BD	① "	① 50
3. ELECTROCLOR S.A.I.C.	(1) Bahia Blanca, B.A.	(1) Polyvinyl Chloride	70	VCM	'86	110
4. FENARGEN S.A.	(1) Ensenada, B.A.	(1) Phenol	33	Cumene (From YPF)	n.a.	50
		(2) Acetone	20	"		
5. FERTINEU S.A.	(1) Plaza Huincil, Neuquen	(1) Ammonia	100	Natural Gas	'88	65
		(2) Urea	100			
6. FERTINOA	(1) Salta	(1) Ammonia	① 60	Natural Gas	① 01/'88	① 40
		(2) Urea	100	Ammonia, CO_2	n.a.	70
7. INDOQUIN S.A. (DOW)	(1) San Lorenzo, St. Fe	(1) Propylene Glycols	10	Propylene Oxide	'86	13
		(2) Propylene Oxide	① 66	Propylene		① 60
		(3) NR Rubber	① 5	AR	① 01/'87	① 5
		(4) SB Latex	① 2	SM, BD	① 01/'87	① 2

Table III-2-32 (Continued)

(tons/year)

COMPANY	LOCATION	PRODUCTS	CAPACITY (1,000 T/Y)	RAW MATERIALS	START UP	REMARKS Investment Cost(10^6 US$)
8. INDUPA S.A.I.C.	(1) Bahia Blanca, B.A.	(1) Polyvinyl Chloride	58	VCM	12/'86	100
		(2) Urea	575		n.a.	300
		(3) Ammonia	345			
9. Y.P.F.	(1) Ensenada, B.A.	(1) Normal Paraffin	① 25 ③ 3	Kerosene	① 01/'87	① 10
		(2) Linear AB	① 50	N-Paraffin, Benzene	③ '85	① 20
10. MONOMERS VINILICOS	(1) Bahia Blanca, B.A.	(1) Vinyl Chloride	130	Ethylene, Chlorine	'86	110
11. PEREZ COMPANC - CAF	(1) Punta Loyola, Santa Cruz	(1) Ammonia	② 400	Natural Gas	n.a.	340
		(2) Urea	①, ② 525			
12. PETROPOL S.M.	(1) Bahia Blanca, B.A.	(1) High Density P.E	62		11/'86	
13. PASA PETROQUIMICA ARGENTINA S.A.	(1) P.G. San Martin, St.Fe San Lorenzo, St. Fe	(1) SM (Modification)	10	EB	09/'86	17
14. PETROQUIMICA AUSTRAL S.A.	(1) Isla Grande, Tierra del Fuego	(1) Methanol	680	Natural Gas	n.a.	226
	(2) Tierra del Fuego	(1) Acetic Acid	① 42	Methanol	① 01/'87	① 50
		(2) Formic Alcohol	① 40	Methanol	① 01/'87	① 40
		(3) Butylenes	① 100	Butane	① 01/'88	① 80
		(4) MTBE	① 150	Methanol, Butylene	① 01/'88	① 45
15. PETROQUIMICA BAHIA BLANCA S.A.	(1) Bahia Blanca, B.A.	(1) Ethylene	45	Propane, butane, naphtha	12/'86	300
		(Expansion)	120		10/'87	
		(2) Propylene	75.5	Byproducts	'86	
		(3) Mix C_4	34.7			
		(4) Pyrolysis Gasoline	② 38.3			
		(5) Pyrolysis Fuel Oil	② 3.9			
		(6) Hydrogen	② 9.9			
		(7) Methane	108.5			
16. PETROQUIMICA CUYO S.A.I.C.	(1) Lujan de Cuyo Mendoza	(1) Polypropylene	40	Propylene	'88	107

Table III-2-32 (Continued) (tons/year)

COMPANY	LOCATION	PRODUCTS	CAPACITY (1,000 T/Y)	RAW MATERIALS	START UP	REMARKS Investment Cost(10^6 US$)
17. PETROQUIMICA GENERAL MOSCONI S.A.I.C.	(1) Ensenada, B.A.	(1) Dimethyl Terephthalate	45	p-Xylene	'88	① 30
		(2) Oxoalcohols	33			
		(3) Butene - 1	25	C_3, C_4 Mixture	'88	106
		(4) MTBE	39	Methanol		
		(5) Formic Acid	② 5			
		(6) Polymerizer Dimersol	③ 35.1			
		(7) Cyclohexane	① 45	Benzene	① 01/'88	① 25
		(8) Phthalic Anhydride	① 27	o-Xylene	① 01/'88	① 25
		(9) Est. BTX	① 120	Straight - run Naphtha	① 07/'88	① 20
		(10) Frac. BTX	① 120		① "	① 10
		(11) HDA	① 40		① "	① 15
		(12) o-Xylene	① 40		① "	① 20
18. PETROQUIMICA RIO III S.A.	(1) Rio Tercero, Cordoba	(1) TDI	① 11	Toluene, Nitric Acid	① 01/ 90	① 25

Sources: Collected data in Argentine
① 'INFORMACION ESPECIAL' DIA DE LA PETROQUIMICA 1985
② LA INDUSTRIA PETROQUIMICA EN LA ARGENTINA 1984
③ HDI Construction Boxcore June, 1985

3) New PVC plant by ELECTROCLOR

DUPERIAL is the substantial promoter for PVC of ELECTROCLOR. The PVC production is being planned but the actual construction is not proceeding yet. This project, however, is closely related to the new ethylene plant installation planned by PBB, and a precise study should be carried out in connection with the overall complex planning.

(b) New projects in Mendoza

1) Expansion of FCC capacity by YPF

In addition to the existing F.C.C. with capacity of 20,000 barrels/day, a new F.C.C. with capacity of 21,000 barrels/day is under construction. On completion of the new unit, 55,000 t/y of propylene can be recovered from F.C.C. off gas, of which about 40,000 t/y is scheduled to be supplied for the polypropylene of Petroquimica Cuyo.

It is also possible to recover butylenes from the off gas. Of these butylenes, isobutylene, together with methanol, is scheduled to be used to produce MTBE, but plan is not concrete yet.

2) New polypropylene plant by Petroquimica Cuyo

Petroquimica Cuyo, a company of domestic capital, is now promoting a production plan to utilize propylene from YPF, and will produce polypropylene of 20,000 t/y in 1988 and additional 20,000 t/y in 1989, in total of 40,000 t/y. Polypropylene is going to fill the domestic demand, through the competition with the existing resins (LDPE, LLDPE, PS and PVC) in the price and performance. As already shown in industrialized countries, polypropylene is expected to be growing at a high rate, so the prospects in the future seems also hopeful.

(c) New projects in Ensenada

1) Potential for utilizing raw materials of YPF

YPF has the biggest oil refinery in Ensenada with the international competitive scale of 230,000 B.D. As related to petrochemical raw materials, it seems possible to use propane, butane, naphtha, and gas oil from the topper, and propylene and butylenes recovered from off gas of F.C.C. (4,000 B.D.). So, the efficiency seems to be improved by the integration with petrochemical and refinery industries including PGM and IPAKO.

2) New projects by PGM

The first phase project which is now in promotion including oxoalcohol, MTBE, and butene-1 is planned to be completed at the end of 1988. The contract of licences and detailed design is said to be agreed with the overseas process owner in March 1986.

- Oxoalcohols (35,000 t/y): An amount of 15,000 - 20,000 t/y is scheduled to be consumed in the form of isooctanol, etc., to produce flexible PVC. The remaining will be used as intermediates in Bahia Blanca.

- MTBE (38,000 t/y): Nonleaded gasoline is not necessary in Argentina, so all the product is exported to USA and Western Europe.

- Butene-1 (25,000 t/y): An amount of 15,000 t/y is exported to the USA, Western Europe, and Japan, and 10,000 t/y is used as raw materials for LLDPE and HDPE in Bahia Blanca.

- Propylene and butylenes (120,000 t/y), methanol (15,000 t/y), and natural gas (63,000 m^3/day) are used as raw materials.

The second phase project including DMT and PET is now also in promotion to be completed in 1988. The proposals for licences and detailed designs from four foreign process owners are now being examined.

- DMT (45,000 t/y): An amount of 25,000 t/y is scheduled to be consumed in the domestic market, 18,000 t/y for PET, and the remaining 2,000 t/y will be exported.

- PET "GT" (for textile; 12,000 t/y): An amount of 5,000 t/y will be consumed in the domestic market, and the remaining 7,000 t/y will be exported.

- PET "GB" (for bottle; 5,000 t/y): An amount of 3,000 t/y will be consumed in the domestic market, and the remaining 2,000 t/y will be exported.

- Paraxylene (27,500 t/y), methanol (10,000 t/y), and EG (6,500 t/y; import will be required) are used as raw materials.

The PGM has been a unique company specialized in aromatic petrochemicals, and fully experienced in the export business. 70% of overall production is currently exported and ranked as the sixth industrial product exporter. These projects, including the new business in the field of C_3 and C_4 derivatives while keeping exporting business, may have good economical rationality through the cooperation with YPF.

(d) Future projects in Neuquen Province

1) Potentials in Neuquen Province

Neuquen Province is in the middle west of Argentina. It is the richest natural gas production area in Argentina (production: 36%, reserves: 62% of the total in Argentina). Because of imbalance between production and consumption, about 20% of natural gas is burnt away. A new plan to recover this natural gas and supply it to a new petrochemical project at a price level of 25 to 30 ¢/million BTU (about the half of the price in Saudi Arabia) is now being negotiated with the central government.

Neuquen province has a total 2,770,000 kW hydraulic power stations, which is equal to 32% of the domestic demand. The reserved potential hydraulic power is as much as 10,000,000 kW. The price of electricity is as low as 1 ¢/kWh (about one eight of the price in Japan). Other resources include crude oil, carbon dioxide, and rock salt. In this situation, if the above-mentioned gas price is approved, the competitive potentiality could be fully appreciated.

2) Petrochemical projects in Neuquen Province

The following medium- and long-term plans (after 1990) are now being studied.

a) The first phase petrochemical projects

Vinyl acetate	(30,000 t/y)	Ethylene
Ethylene oxide	(50,000 t/y)	derivatives
Ethylene glycol	(40,000 t/y)	
Acrylonitrile	(60,000 t/y)	Propylene
Oxoalcohol	(40,000 t/y)	derivatives
Propylene oxide	(35,000 t/y)	

Since these products are not produced in the country now, such plan may be reasonable. However in the case of ethylene derivatives it seems more reasonable to concentrate them in Bahia Blanca complex which already started production. It is said that the oxoalcohol plan would be suspended, because this product has already been promoted by PGM.

b) The second phase petrochemical projects

Polyethylene	(100,000 t/y)
Polypropylene	(40,000 t/y)

As for these products, projects in Bahia Blanca and Mendoza have been proceding in advance. Therefore, Neuquen's plan will be considerably postponed, and probably realized in the late 1990s if they seek the domestic market. In order to realize the project, it should be export-oriented, through organizing a joint ventures with the foreign petrochemical enterprises in industrialized regions having the markets.

c) The petrochemical projects in the next phase

Non-ionic surfactrants	(20,000 t/y)
Ethanolamine	(5,000 t/y)
Glycol ester	(20,000 t/y)
Polyethylene glycol	(2,000 t/y)
Di- and tri-ethylene glycols	(3,000 t/y)

All the products are derivatives of ethylene oxide and ethylene glycol which are both ethylene derivatives. As these are special chemicals, it is more reasonable to install the plants near market. Moreover, as stated in the first phase plan, it seems improper to install these plants of ethylene derivatives in Neuquen Province. After all, these three programs for development of petrochemical industry are summarized as follows. It is reasonable to avoid ethylene and ethylene derivatives, requiring a huge amount of investment cost and facing competitions with a lot of petrochemical industries in resource-rich countries. Rather, it is preferable to introduce the dehydrogenation process which are relatively inexpensive than ethylene plants, and produce propylene and butylenes from propane and butane, and then produce propylene and C_4 derivatives.

d) The ammonia and urea project

There is a plan to produce 100,000 t/y of urea and export one fourth of the production to Chile. Remaining three fourth are to the Pampa area. However, there are many similar projects in Argentina, and the domestic demand can be filled only one plant of a 200,000 - 300,000 t/y scale. In addition, the extensive marketing to Chile will be necessary to realize the export. The project, therefore, must be examined very carefully.

e) The methanol and MTBE projects

Methanol	(13,400 t/y)
MTBE	(35,100 t/y)

The final product MTBE is to be 100% exported, through pipeline transportation to San Antonio on the Atlantic coast. In this plan, the small scale of methanol plant will result in high cost, so the methanol may have to be purchased from outside. It is possible to realize the MTBE project as a derivative of C_4 chemical (isobutylene), together with the petrochemical projects. Similar to the case of ammonia and urea projects, there are a lot of similar projects for MTBE in Argentina. The export market and feasibility for the MTBE project, therefore, should be examined carefully.

f) The ammonia and urea projects

The two projects by FERTINOA and FERTINEU are now in progress.

1) FERTINOA (Campo Duran)

Capacity	:	100,000 t/y (investment; about US$72 million)
Joint partner	:	Czechoslovakia (details unknown)
Current status	:	Under final negotiation for licence and design.
Completion	:	To be 1988. The construction period is 24 months. The beginning of construction is not determined yet.

2) FERTINEU (Plaza Huincle)

Capacity	:	100,000 t/y (investment; about US$75 million)
Joint partner	:	N-REN (USA)
Current status	:	Under final negotiation for licence and design.
Completion	:	To be 1988. The construction period is 24 months. The beginning of construction is not determined yet.

Each project is based on activities through a joint venture. For the realization of the ammonia and urea projects, the stabilization of international crude oil market is necessary that will result in the recovery of market prices of ammonia and urea. Also coordination of many planned projects is necessary.

(3) Locational potentials in Argentine petrochemical industry

The drastic decline of oil-price (prices of raw material and energy) makes it difficult to forecast the feasibility of future projects, and therefore, a large-scale new petrochemical projects are suggested to be postponed until the oil situation is stabilized. However, the world resources of hydrocarbons are limited, which should inevitably lead to petrochemical projects realized in areas where the raw material cost is low. The feasibility of the new petrochemical projects in Argentina can be summarized, in terms of schedule and locations, as follows.

(a) Short-term viewpoint

- Revamping of the existing ethylene plant and completion of HDPE, VCM, and PCV plants in Bahia Blanca complex.
- Revamping of the existing ethylene and SM plants in Santa Fe complex.

(b) Medium-term viewpoint

- By introducing the new ethylene plant in Bahia Blanca, to establish a well-balanced downstreams of derivatives, resulting in the strengthened overall petrochemical complex.
- The realization of projects for C_3 and C_4 derivatives through integration of YPF and PGM in Ensenada complex.
- Completion of the polypropylene plant utilizing FCC propylene in Mendoza as a raw material.

(c) Long-term viewpoint

The realization of projects with internationally competitive products in resource-rich areas.

- The realization of projects for C_3 and C_4 derivatives in Neuquen.
- The realization of projects for a methanol, ammonia, and urea at a location where natural gas is produced and convenient to transport its products.

(4) Constraints and suggested petrochemical industry policy

Major items are listed below.

(a) Constraints in the development of Argentine petrochemical industry

1) Insufficient capital and high interest rate.
2) Insufficient stability and consistency of economic policy.
3) The presence of export and import duties.
4) Insufficient reinvestment activities.
5) Different interests of organizations in petrochemical industry and insufficient governmental coordination in overall adjustment.
6) Insufficient information and analysis for the international market trend of petrochemical industry.
7) Tendency to increasing of investment cost.

(b) Suggested petrochemical industry policy

1) Policy to promote the investment including foreign capitals.
2) Establishment of stability and consistency in economic policy.
3) Abolishing the export duty and reducing the import duty stepwise and in timely manner.
4) Promoting governmental coordination in overall adjustment such as settling the priority among new projects.
5) Acquisition of information on the international market trend and its quick and periodical evaluation.
6) Searching and executing the reasonable method to reduce the investment cost.

2-4 Selection of Argentine Petrochemical Products with Some Prospects

2-4-1 Criteria for Selection

The petrochemicals with some prospects will be selected based on the following criteria.

(1) Macroscopic criteria

1) Improvement in balance of payment resulting from reduction of import or increasing of export by domestic production.
2) Contribution to the overall national economy of Argentina based on the added values to raw materials, natural gas and petroleum products, and investment cost.
3) Petrochemical products that would help to improve industrial structure and contribute the export promotion of industrial products.
4) Increase of employment in related industries and promotion of regional development through the project implementation.
5) The petrochemical products which have a lot of possibility of application in the future.
6) Secondary benefit provided to consumers in Argentina, in the form of price reduction and improvement on the serviceability.
7) Any other petrochemicals that would be suitable for the domestic situation in Argentina.

(2) Actual criteria

1) Petrochemical products which are expected to have strong domestic demand and international demand.
2) Petrochemicals in which large amount of domestic resources is used, as far as having economic rationality.
3) Petrochemicals which do not have a large difference between the size of domestic demand and the economic scale of the plant. If the ratio of export is high, petrochemicals which have international competitiveness.
4) If the ratio of export is high, the transportation of products will be important. Furthermore, expected volume in international trade should be large enough for a new-comer.
5) If a new plant is located in existing complex, the products should help improving the balance of raw materials and intermediates.
6) Petrochemicals of which plant is already in high operating rate, and the product which will be difficult for current plant capacity to meet the increasing demand.
7) When there are a lot of small existing plants, the method of scrap and build should be studied. In this case, products should have economic rationality owing to adopting modern technology and scale effect.

2-4-2 Petrochemical Products with Some Prospects

Table III-2-33 shows the evaluation results of 65 petrochemicals. The number in the table is corresponding to the number of selection criteria, and we put actual figures to quantitatively expressible items in the columns, based on the following documents.

- Macroscopic criteria:

  1); APLA, Anuario Petroquimico Latinoamericano 1985.

- Actual criteria:

  1), 4); SRI International, World Petrochemicals 1984.

  3), 6), 7); APLA, Anuario Petroquimico Latinoamericano 1985.

For evaluation in each selection criterion, products are classified into three ranks of A, B and C. But, we have not given rank to macroscopic reference 7) because there are many indefinite evaluation parameters: also we have not given rank to substantial reference 5) because its evaluation belongs to individual project assuming its location. The integral evaluation results are shown in the right end of the table, where ranks A, B, and C mean the following product groups:

A: Prospective products
B: Products having future potentials
C: Products having less potentials

The results and reasons for the selection are as follows.

(1) Products with some prospects

(a) Ethylene derivatives

1) Ethylene

The most significant and basic petrochemical with a lot of future possibilities for application. The price of raw material (ethane) is cheap enough having the potentiality to become competitive in international market. Also, the existing plants are operating at high rate. Currently, PBB company has a expansion plan of 45,000 t/y and DUPERIAL company of 7,000 t/y. The new large project, however, requires overall investigation, considering high investment cost of ethylene plant and serious competition among a lot of resource-rich countries.

2) HDPE

Now, POLISUR in Bahia Blanca is producing HDPE by using the plant for LLDPE, but an HDPE-dedicated plant is necessary to improve the quality and productivity. HDPE is a polyethylene whose application fields are different from those of LDPE and LLDPE. So its production is expected to enhance the nation's convenience and to improve the balance of payment by substituting for imported products. Currently, PETROPOL company is constructing a new equipment of 32,000 t/y in Bahia Blanca.

Table III-2-33 Result of Selecting Promising Petrochemical Products

(1,000 tons)

	PRODUCTS	Macroscopic Criteria: 1) Foreign trading balance: Import 1984	Export 1984	Rank	2) Economic contribution	3) Industrial structure	4) Employment & development	5) Future application	6) Secondary benefit	7) Suitability in Argentina	Actual Criteria: 1) Demand forcast: Annual growth rate(%) ('89/'84) Argentina	World	2) Raw materials available in Argentina	Rank	3) Demand & Economic scale: Domestic demand ('84)	Economic scale (Min.)	4) Exportability: Rank	Transportability	World trade ('84)	Rank	5) Balance in existing complex	6) Operating load: Utilization (%) ('84)	Rank	7) Existing plants: Total cap. No. of plants	Capacity range	Rank	Integral judgement for prospective products	
1	Ethylene	0	46	C	A	B	A	A	B		5.8	2.0	B Ethane, Naphtha	A	211	200	A	C-L	415	C		101.2	A	254/4	15~200	A	A	1
2	LDPE/LLDPE	1	58	C	A	A	A	A	A		6.9	2.3	B Ethylene	B	80	50	A	B-S	1519	A		60.7	C	225/4	15~120	B	B	2
3	HDPE	23	6	A	A	A	A	A	A		10.0	4.2	A 〃	B	38.5	30	A	B-S	968	A		18	C	120/1	120	C	A	3
4	Ethylene oxide	-	-	B	B	B	B	A	B			2.7	C 〃	B	-	50	C	C-L	29	C		-		-	-	A	B	4
5	Ethylene glycol	7.9	0	A	B	B	B	A	B		12.9	2.0	A 〃	B	7.9	50	C	A-L	608	A		-		-	-	A	B	5
6	Polyester fibers	15.9	0	A	B	B	B	B	A		7.3	3.3	B EG, TPA or DMT	C	23.7	20	A	B-S	667	A		29.2	C	26.7/5	0.8~15.4	A	B	6
7	Ethylene dichloride	-	-	B	A	B	B	B	B		∞ (0→188)	3.4	A Ethylene, Chlorine	B	-	100	B	A-L	825	A		-		-	-	A	A	7
8	Vinyl chloride monomer	0	0	B	A	B	B	B	B		16.1	3.1	A EDC, Ethylene	B	55.5	100	B	B-L	642	A		88.8	A	62.5/2	30.5~32	B	A	8
9	Polyvinyl chloride	15.6	0.1	A	A	A	A	A	A		8.1	3.0	B VCM	B	69.1	50	A	B-S	864	A		90.8	A	59/2	29~30	B	A	9
10	Ethylbenzene	0	0	B	B	B	B	A	B		5.1	2.8	B Ethylene, Benzene	B	71	100	B	A-L	209	B		107.6	A	66/1	66	C	B	10
11	Styrene monomer	1	6	C	B	B	B	A	B		7.8	3.1	B 〃	B	52	100	B	A-L	903	A		105.7	A	54/1	54	C	B	11
12	Polystyrene	3.1	0.9	B	B	A	A	A	A		5.9	3.1	B SM	B	31.5	30	A	B-S	453	B		61.2	C	47.9/5	0.9~31	A	B	12
13	SBR	0.6	13.7	C	B	A	B	B	A		4.8	3.2	C SM, Butadiene	B	32.9	30	A	B-S	292	B		92	A	50/1	50	C	B	13
14	ABS & SAN	0	0	B	B	A	B	A	A		5.2	5.3	B AN, SM, Butadiene	C	7.7	40	C	B-S	209	B		70	B	11/3	1~5	A	B	14
15	Ethyl acetate	0	4	C	C	B	C	B	B				Acetaldehyde	B	4	20	C	A-L	291	A		98.7	A	8/1	8	A	B	15
16	Vinyl acetate	7	0	A	C	B	C	B	B		6.6	2.7	B Ethylene, Acetic acid	B	7	50	C	B-L				-		-	-	A	B	16
17	Acetaldehyde	0	0	B	C	C	C	C	C				Ethylene or Ethanol	B	10	50	C	B-L				86.9	A	11.5/3	2.6~5.6	B	C	17
18	Propylene	0	0	B	A	B	B	A	B		22.1	2.7	A Naphtha, LPG, Crude oil	A	(32)	100	B	B-L	418	B		(21.5)	C	149/4	20~48	B	B	18
19	Polypropylene	32.5	0	A	A	A	A	A	A		8.0	4.9	A Propylene	A	32.5	50	B	B-S	970	A		-		-	-	A	A	19
20	Propylene oxide	3.2	0	B	B	B	B	B	B		5.2	2.2	B 〃	A	3.2	30	C	B-L	359	B		-		-	-	A	B	20
21	Propyrene glycol	6	0	A	B	B	B	B	B				〃	A	6	30	C	A-L				-		-	-	A	B	21
22	Acrylonitorile	13.5	0	A	A	B	B	A	A		6.8	3.2	B Propylene	A	13.5	60	C	B-L	449	B		-		-	-	A	A	22
23	Acrylic fiber	3.8	0	B	B	A	B	B	A		13.0	2.7	A AN	B	19.4	20	A	B-S	437	B		94.5	A	16.5/1	16.5	C	B	23
24	Isopropyl alcohol	0	17	C	B	B	C	C	B		5.9	3.7	B Refinery gas	A	15.4	30	B	A-L	186	B		91	A	35.6/1	35.6	C	B	24
25	Oxo alcohol	(15)	(0)	A	A	B	B	A	A		5.9	1.4	B Propylene, Oxo gas	A	(15)	50	C	A-L	246	B		-		-	-	A	A	25
26	n-Butanol	1.2	0	B	B	B	B	B	B			1.5	C 〃	A	(2)	20	C	A-L	26	C		-		-	-	A	C	26
27	2-Ethylhexanol	(1983) 15	0	A	A	B	B	A	A		6.7	1.1	B 〃	A	(1983) 15	50	C	A-L	304	B		-		-	-	A	A	27
28	Cumene	0	0	B	B	B	C	C	C			1.8	C Propylene, Benzene	B	0	50	C	A-L	291	B		0		46/1	46	C	C	28
29	Phenol	9.8	0	A	B	B	C	B	B		6.6	2.2	B 〃	B	9.8	50	C	A-L	355	B		-		-	-	A	C	29
30	Aceton	0	0.5	B	B	B	C	B	C		6.6	2.8	B Maiz or IPA	B	7.2	30	C	A-L	128	C		60.2	C	12.8/3	0.4~12	A	C	30
31	Oligomers		(4)	C	C	B	C	B	B			2.0	C Propylene	A		10	C	A-L	187	B		(18.2)	C	22/1	22	C	C	31
32	MIBK			B	C	C	C	C	C				Acetone	B		20		A-L						3/1	3	A	C	32
33	Acrylic acid	0	0	B	B	A	B	A	A				Propylene	A	0	20	C	B-L				-		-	-	A	B	33
34	Benzene	(1983) 0	65	C	B	B	B	B	B		3.2	2.8	C Naphtha, Crude oil	B	(1983) 101	100	A	A-L	647	A		115.5	A	144/2	60~84	B	B	34
35	Toluene	(1983) 0	1.4	B	B	B	B	B	B		3.0	3.1	C 〃	B	(1982) 123	50	A	A-L	403	A		170.8	A	73/2	33~40	B	B	35
36	p-Xylene	0	30	C	B	B	B	B	B		∞ (0→22)	3.4	A 〃	B	0	50	C	A-L	479	A		110	A	35/1	35	B	B	36
37	o-Xylene	0	3	B	B	B	B	B	B		2.8	2.5	C 〃	B	21.6	30	B	A-L	221	A		107	A	23/1	23	B	B	37
38	Cyclohexane	0	38.6	C	B	B	B	B	B			3.3	C Benzene, Hydrogen	C	0	40	C	A-L	147	B		99	A	42/1	42	C	B	38
39	Adipic acid	13	0	A	B	B	B	B	B		4.8	2.3	C Benzene	C	13	30	B	B-S	80	C		-		-	-	A	B	39
40	Caprolactam	7.4	0	A	B	B	B	B	B		12.5	2.3	A Cyclohexane, Ammonia	C	7.4	50	C	B-L	254	B		-		-	-	A	B	40
41	Nylon 6	0.6	0	B	B	A	B	B	A		8.4	2.1	B Caprolactam	C	5.6	20	B	B-S	153	B		22.1	C	22.6/5	0.2~16.5	A	B	41
42	Nylon 66	0	0	B	B	A	B	B	A		2.7	1.9	C Adipic acid	C	18.4	20	A	B-S	68	C		85.2	A	21.6/1	21.6	C	B	42
43	Maleic anhydride	-	1.4	B	C	C	C	B	B		5.9	4.3	B Butane	B	1.4	20	C	B-L	49	C		40	C	7/1	7	B	C	43
44	Toluene diisocyanate	0	5.7	C	B	B	C	B	A		9.5	3.4	B Toluene, Nitric acid	C	7.2	20	B	A-L	209	A		80.2	B	16/1	16	C	B	44
45	DMT	7.2	0	A	B	A	B	A	A		45.0	2.8	A p-Xylene	B	7.2	50	C	B-S	292	B		-		-	-	A	B	45
46	TPA	2.2	0	B	B	A	B	A	A			7.3	C 〃	B	2.2	50	C	B-S	613	A		-		-	-	A	B	46
47	Phthalic anhydride	(1983) -	5.6	B	B	B	B	B	B		8.4	2.5	B o-Xylene	C	(1983) 15.1	30	B	B-L	145	B		(1983) 87	A	23.8/2	12.4~14	B	B	47
48	Aromatic solvent			B	C	C	C	C	C				Aromatics	B	11			A-L				86.8	A	15/1	15	C	C	48
49	Alkylbenzene	(1983) 0	18.6	C	B	B	B	B	B				Benzene	C	(1983) 22.2	30	A	A-L				(1983) 102	A	40/1	40	C	B	49
50	Butadiene	0	0	B	B	B	B	A	B		2.0	2.8	C Butane	A	28	50	B	B-L	651	A		84.8	B	33/1	33	B	B	50
51	Butylene	0	0	B	B	B	B	A	B				〃	A		50	B	A-L						102/3	6~70	B	B	51
52	Polybutadiene rubber	9.4	0	A	C	A	C	B	A		9.5	3.0	B Butadiene	B	9.4	30	C	B-S	186	B		-		-	-	A	B	52
53	Polychloroprene rubber	(3)		B	C	A	C	B	A		5.9	2.5	B	B	(3)	20	C	B-S	105	B		-		-	-	A	B	53
54	Nitrile rubber	(1)		B	C	A	C	B	A		14.9	3.1	A	B	(1)	10	C	B-S	51	C		-		-	-	A	B	54
55	Butyl rubber	(4)		B	C	A	C	B	A		8.4	2.5	B Iso-Butylene	A	(4)	30	C	B-S	178	B		-		-	-	A	B	55
56	Methyl tert-butyl ether	0	0	B	B	C	A	C	B			7.1	A Methanol, iso-Butylene	A	-	60	B	A-L	85	C		-		-	-	A	A	56
57	Sec-butanol		1.5	B	C	C	C	C	C				Butylene	A	3	10	B	A-L				77.7	B	6/1	6	B	C	57
58	Metyl ethyl ketone		0.3	B	C	C	C	C	C				Sec-butanol	B	10	30	B	A-L				38.9	C	15/1	15	B	C	58
59	Methanol	3	0.6	B	A	C	A	A	B				Natural gas	A	33.7	300	C	A-L		A		92.1	A	34/2	14~20	A	A	59
60	Formaldehyde (37%)	0	0	B	B	B	B	B	B				Methanol	A	41	50	A	A-L				40.6	C	101/4	3~48	B	B	60
61	Acetic acid	0	0	B	B	C	B	B	B				Ethanol or Acetaldehyde	B	13.1	100	C	B-L				88	A	14.9/3	3.3~7.3	A	B	61
62	Fumaric acid				C	C	C	C	C				Maleic acid	C		10		B-S						1/1	1	A	C	62
63	Urea	86	0.5	A	A	B	A	B	A				Ammonia, CO2	A	172.5	300	B	B-S				87.9	A	99/1	99	A	A	63
64	Urea resin			B	B	B	B	B	B				Urea, Formaldehyde	B	13	5	A	B-L				38.2	C	32.8/		C	B	64
65	Ammonia	2.7	0.2	B	A	B	A	A	A				Natural gas	A	72.6	300	C	B-L	5375	A		79.9	B	87.6/3	3~72.6	A	A	65

3) EDC, VCM, and PVC

PVC is one of the major plastics together with LDPE. PVC is manufactured from ethylene through EDC and VCM in most countries in the world, but in Argentina, it is produced from acetylene. The application of ethylene method is expected to reduce the production cost. The increased production capacity is expected to improve the foreign trade balance by substituting for imported products and by exporting some of products. Currently, INDUPA company, as the promotor, is constructing new plant for 130,000 t/y of EDC and VCM and for 58,000 t/y of PVC in Bahia Blanca.

(b) Propylene derivatives

In Argentina, propylene can be recovered from the FCC off gas with a favorable cost, giving strong cost competitiveness to propylene derivatives.

1) Polypropylene

It is considered plastics having the highest growth rate in future. It is the most prospective product that can be ranked high from every viewpoint because it is not domestically produced. Its cost competitiveness is high. Currently, Petroquimica Cuyo's plan of 40,000 t/y in Mendoza is in progress. Other projects may be feasible because of export possibility.

2) Acrylonitrile

As an intermediate for acrylic fibers and ABS, the acrylonitrile is a major propylene derivative following polypropylene. Because it is not domestically produced and its cost competitiveness is high, it seems possible to realize a new project, considering the export market in addition to substitute for import products.

3) Oxoalcohols

As intermediates for surfactants, solvents, perfumes, and plasticisers, the oxoalcohols have wide application fields. The prices of both raw material propylene and butylenes and submaterial oxo gas are cheap enough to keep their cost competitiveness. These are not domestically produced yet, so it is expected to improve the balance of payment by substituting for imported products and by exporting some of products. Currently, PGM company is promoting a new project of 35,000 t/y in Ensenada.

4) Octanol

As an intermediate for surfactants, synthetic lubricating agents, and plasticisers, the octanol has wide application fields. The prices of both raw material propylene and submaterial oxo gas are cheap, and therefore, its cost competitiveness is remarkable. Also, it is not domestically produced yet, so it is expected to improve the balance of payment by substituting for imported products

and by exporting some of products. Introducing the oxo process, butanol can be produced simultaneously, if necessary.

(c) Aromatic derivatives

In Argentina, PGM is a major supplier of the basic aromatic materials. As aromatics are important export products and sold at the international price, the aromatic derivatives in Argentina have not cost competitiveness if aromatic itself is sold to downstream makers at the international price. However, if the PGM company itself plans a new project, it can freely determine the prices as captive using prices while maximizing the added value of aromatic raw materials to final products, so it may be possible to have cost competitiveness.

As an intermediate for polyester fibers and resins, demand of DMT growth is prospective. It is not domestically produced yet, and polyester fibers and DMT are imported. So its production is expected to improve the balance of payment by substituting for imported products and by exporting some of products.

Recently, the demand for PET bottle is rapidly increasing in the world, and domestic production of DMT, will be desirable together with PET production. Currently, PGM company is promoting projects for 45,000 t/y of DMT and 17,000 t/y in total of PET in Ensenada. These projects are considered to be feasible because of the above-stated reason.

(d) C_4 derivatives

Butane is recovered from natural gas and butylenes are recovered from FCC gas in refineries, both with very favorable prices. Therefore, C_4 derivatives have strong cost competitiveness. It should be taking into account, however, that the producing butylenes and butadiene from butane requires a dehydrogenation process and that the effective butylenes concentration is lower in FCC gas than in spent C_4 stream of naphtha crackers.

As an agent of octane-value booster for non-lead gasoline, MTBE market is large mainly in the USA. The MTBE has a favorable cost competitiveness using isobutylene and methanol as raw materials. The production of MTBE is also effective as a process to separate isobutylene and butene-1 which are two of most effective components in butylenes (in the MTBE process isobutylene makes selective reaction). Thus, it is reasonable to produce butene-1 at the same time.

In Argentina, there is no regulation for leaded gasoline, and therefore MTBE has no domestic market and exported 100% of the product to obtain foreign currency. Currently, PGM is promoting projects for 38,000 t/y of MTBE and 25,000 t/y of butene-1, together with the project for oxoalcohols. There are a lot of projects for MTBE, it is reasonable to realize them step by step to meet the amount recovered from FCC off gas.

(e) Natural gas derivatives

Argentina has abundant natural gas resource, with relatively low recovery cost which makes the industry, cost competitive. It should be noted, however, that a lot of resource-rich countries are constructing large-scale, export-oriented plants in this field, making supply excessive, and that the market price is declining, reflecting recent decrease of oil price.

1) Methanol

It has a wide range of application fields, as an intermediate for chemicals such as MTBE, acetic acid, formaldehyde, methyl metha acrylate (MMA), di methyl terephtahalate (DMT), polyvinyle alcohol (PVA), and chloromethane, or gasoline blend and fuel. Its domestic market and production scale are small now. If the project of methanol is going to be implemented, it should be an export-oriented and large-scale plant, supported by high cost competitiveness.

In countries having natural gas resource, the variable cost is low and so the business is the capital intensive type, and therefore, the fixed cost must be reduced by large scale plant - up to about 300,000 t/y or more of the production capacity. The realization of the project might be feasible when the international oil market is stabilized.

There are a lot of projects including Petroquimica Austral of 680,000 t/y. It seems reasonable to concentrate the methanol projects into a large plant by giving the priority to the suitable project having the advantages in the points of capital and raw material as well as transport convenience.

2) Ammonia and urea

It has a wide range of application fields, in addition to nitrogen fertilizer, as raw material for acrylonitrile, caprolactum, urea resin, and melamine resin. Similar to methanol, the ammonia-urea is the capital intensive type, requiring a large-scale plant more then 300,000 t/y of production, and very high investment cost. As a difference from methanol, it should taking into account that there exists a middle-scale ammonia-urea plant, the domestic demand of urea reaches about 200,000 t/y, as a result, a new project should consider both aspects of domestic and export markets. However similar to methanol, the time to realize the new project should be waited after the stabilization of oil price. If it is implemented it should be a large-scale plant, through the selection from a lot of projects based on the priority.

(2) Products with some prospects in future

(a) Ethylene derivatives

Generally speaking, the cost competitiveness of ethylene derivatives in Argentina is about the same as in Western Europe, the projects aiming at export are difficult to realize because there are a

lot of competitors, including Saudi Arabia. It is therefore necessary to carry out projects step by step to meet the growth rate of the domestic demand for ethylene derivatives.

1) LDPE and LLDPE

They are major plastics with its growth rate expected to be nearly equal to that of GDP. For the time being, it is not necessary to increase the capacity because the large plant of 190,000 t/y in total has been operating in Bahia Blanca.

2) Ethylene oxide and ethylene glycol

They are not yet domestically produced. Its future application is very prospective as a raw material for surfactants and polyester fibers and resins. It may be considered, however, that a lot of projects for ethylene glycol have been realized in resource-rich countries, also declining of the international market price makes their import easier. It is therefore unnecessary to construct a new plant for a while.

3) Polyester fibers

Imported volume is fairly large, but the operation rate of the existing plants are low, so for the time being, there is no need for a new plant. From the viewpoint of rationalization of existing plants, the scrap-and-build scheme should be investigated.

4) Ethylbenzene, styrene, polystyrene, and SBR

The growth rates of demand are not so high. There are medium scale plants and demand may be satisfied by revamping of the existing plants.

5) ABS

In the industrial advanced regions, the ABS has the highest growth rate among the general-purpose resins, but in Argentina, its demand growth is nearly equal to other plastics, and the operation rate is also small. There are several small-scale plants, so the introduction of a new technology and scrap-and-build scheme should be studied to improve the product quality and to decrease the production cost.

6) Ethyl acetate and vinyl acetate

The domestic demand for both products have not reached the economical scale of the plant, so new plant is unnecessary for a while.

(b) Propylene derivatives

The price level of propylene is low enough when recovered from FCC off gas, but the recoverable quantity is limited. It is reasonable, therefore, to supply this cheap propylene to the priority projects such as polypropylene and acrylonitrile. For other

products, propylene is to be produced as a byproduct in naphtha crackers or from dehydrogenation of propane, so the resulting cost competitiveness is not always strong. Like ethylene derivatives, it is necessary to carry out projects step by step to meet the growth rate of the domestic demand.

1) Propylene oxide and propylene glycol

It is not yet domestically produced, but, the imported quantity (domestic demand) has not reached the economical scale of the plant, so new plant is unnecessary for a while.

2) Acrylic fiber

The existing plant nearly reaches the economical scale and only a small volume is imported. But, the growth rate of demand is expected to be high, so a new plant may be feasible once the acrylonitrile project is realized.

3) Acrylic acid and acrylic esters

These products are rapidly growing in advanced countries as raw materials for adhesives, paints, and highly water-absorbent resins. In Argentina, however, the market seems to be not developed yet.

The market should be developed by importing the final products until the demand scale of these products are considerably large, then the production scheme from raw material could be carried out.

(c) Aromatic derivatives

As stated before, the prices of aromatics are the same as the international market prices, so there are less cost competitiveness for aromatic derivatives, unless PGM company does make a direct business in this field. Projects other than that of PGM for export might be steadily realized to meet the domestic demand.

1) Products from PGM company

These products include benzene, toluene, p-xylene, o-xylene, cyclohexane, and alkylbenzene. The economical reasonability for these products should be pursued while considering both aspects of domestic demand and export. Aromatic raw materials should be supplied at lower prices for adipic acid and caprolactam, which have high growth potential and are not produced in Argentina. And if so, the domestic demand is expected to be growing.

2) Products having no production capacity

The domestic demands (import amount) for adipic acid, caprolactam, and telphthalic acid (TPA), raw materials for synthetic fibers, do not reach the economical scale of plant for a while. Therefore, their domestic production should be considered to meet increased domestic demand of nylon 6, nylon 66, and polyester fibers.

3) Nylon 6 and nylon 66

Their prospective application fields extend from synthetic fibers to engineering plastics. The demand growth rate of nylon 6 seems to be high, but there are many small plants and their operation rate is low. Therefore, it is necessary to introduce a new technology and the scrap-and-build scheme to improve the product quality and production cost. For nylon 66, there is an existing plant reaching the economical scale with high operation rate, so that the demand may be satisfied by revamping of the plant.

4) Other products

There exists medium-scale plants for TDI which is raw material for polyurethane, and phthalic anhydride which is an intermediate for plasticisers, paints, and resins. Because the domestic demand does not reach the economical plant scale, new plant is unnecessary for the time being.

(d) C_4's and their derivatives

1) Butadiene and butylenes

Butadiene and butylene are the basic raw materials for C_4's derivatives. In Argentina, these are recovered from FCC off gas or from dehydrogenation process of butane recovered from natural gas, both at very favorable prices. The existing plant can meet the demand for a while, but it is necessary to study the revamping of the plants to prepare for the expansion of C_4's derivatives which are substantially competitive in cost.

2) Special synthetic rubbers from C_4's

Four synthetic rubbers, polybutadiene, polychloroprene, nitrile, and butyl rubbers are not yet domestically manufactured. But, the imported quantity (domestic demand) has not reached the economical scale of the plant, so new plants are not necessary for the time being. However, when the level of industrialization goes up, more high-quality rubber will be inevitably required. As a result, growth rate of demand will be expected high and the study of new projects should be continued.

(e) Natural gas derivatives

1) Formaldehyde

Derived from methanol, formaldehyde has a wide application range as raw materials for phenol, urea, melamine, and polycarbonate resines. There are many plants, including the plant reaching the economical plant scale, but the overall operation rate is low. If large methanol project could be realized in future, the plant of formaldehyde can obtain cheap methanol, so it might possible to realize a new project by introducing the scrap-and-build scheme.

2) Acetic acid

As raw materials for vinyl acetate, acetic acrylic ester, tetraphthalic acid, and synthetic rubbers, its application range is wide.

Current technology for producing acetic acid in the world, is synthesizing from methanol and CO directly. In Argentina, however, there are some small plants using biomass-ethanol or acetoaldehyde as raw material.

To meet the large methanol project, it is necessary to study the introduction of a large plant using methanol.

3) Urea resin

The urea resin, using formaldehyde (methanol) and urea as raw materials, has a wide application field including adhesives, molding materials, and processing agents for fibers and papers. Thus, when the large methanol-urea project is realized, it is possible to realize a new project having sufficiently strong cost competitiveness.

(3) Products having less potentialities

In this category, there are products having production capacity with low operation rate and with low growth rate of domestic demand. Or products whose application range is narrow and economical influence in Argentina is small. Such products are as follows;

Acetaldehyde, Cumene and phenol, Aceton, Oligomer, MIBK, Maleic anhydride, Aromatic solvent, Sec-butanol, MEK and Fumaric acid

2-5 Preliminary Study for Profitability of Selected Petrochemical Products

The products with some prospects selected in 2-4 are as follows:

- Ethylene
- HDPE
- EDC, VCM, and PVC
- Polypropylene
- Acrylonitrile
- Oxoalcohol
- Octanol
- DMT
- MTBE
- Methanol
- Ammonia and urea

A preliminary attempt is made in this report to evaluate the prospects of the selected products mentioned above, excluding HDPE (PETROPOL company) and EDC, VCM, and PVC (INDUPA group) which are scheduled to be completed in 1986 and oxoalcohols whose product breakdown is not clear.

2-5-1 Assumption for Evaluation

(1) Process and capacity

Unless a special condition exists, we have selected the most up-to-date processes whose unit consumption of raw materials and utilities are improved.

1) Ethylene: Two cases using ethane or naphtha as a raw material are studied, with production capacity of 200,000 t/y.

2) Polypropylene: The homopolymer process of HIMONT/Mitsui Petrochemical Corp. are studied, with production capacity of 40,000 t/y.

3) Acrylonitrile: The MONTEDISON/UOP process is studied, with production capacity of 50,000 t/y.

4) Octanol: The low-pressure oxo-process introducing rhodium cluster catalyst is studied, with production capacity of 50,000 t/y.

5) DMT: The Mitsui Petrochemical process is studied, with production capacity of 45,000 t/y.

6) MTBE: The ARCO Chemical process is studied, using FCC-recovered C4 as a raw material, with production capacity of 38,000 t/y.

7) Methanol: The low-pressure synthetic process using natural gas as a raw material is studied, with production capacity of 680,000 t/y.

8) Ammonia: The SNAMPROGETTI low-pressure synthetic process is studied, with production capacity of 300,000 t/y.

9) Urea: The SNAMPROGETTI ammonia stripping process is studied, with production capacity of 450,000 t/y.

(2) Estimation of Investment Cost

In the field survey, we had got informations on the approximate investment cost for new Argentine projects. Details of the calculation range and breakdown infrastructure, OSBL, and ISBL were unknown, so we made calculation according to the method adopted in section 2-2-4. Because the production capacity is different, we corrected the construction cost by using the scale factor of 0.7. We also used the constant location factor, 130% of the US Gulf Coast. The calculation results are shown in Table III-2-34.

Table III-2-34 Estimates of Investment Amount

(1,000 tons/year, US$ million)

	Capacity	Investment Capital		
		Equipment in B/L	Equipment out of B/L	Total
Ethylene (Ethane)	200	133	66.5	199.5
Ethylene (Naphtha)	200	162	81	243
Polypropylene	40	24	12	36
Acrylonitrile	50	56	28	84
Octanol	50	56	28	84
DMT	45	35	17.5	52.5
MTBE	38	5.3	2.65	7.95
Methanol	680	198	99	297
Ammonia	300	105	52.5	157.5
Urea	450	77	38.5	115.5

2-5-2 Production Cost and International Cost Competitiveness

The international cost competitiveness is discussed here by the comparison of the production cost in Argentina calculated based on 2-2-4, with that in Western Europe as representative of industrialized regions and with Saudi Arabia as representative of resource-rich countries.

(1) Assumptions

1) The calculation results in 2-2-4 can be used for Western Europe and Saudi Arabia.

2) The production cost in Argentina is calculated on the basis of the same assumptions as in 2-2-4, except for the following:

- Adjustment of investment amount according to the difference of the production capacity.

- The annual interest in Argentina is changed from 5% to 10%.

- The price of raw material for DMT project to be carried out by PGM is assumed to be 70% of the international market price, considering the raw material o-xylene is supplied by the company itself.

- The prices of ammonia and methanol are assumed to be the same level in the USA with the expectation of the realization of a large project in the future.

(2) Results of calculation

Table III-2-35 shows the result of calculation. The table indicates that MTBE, methanol, and urea can have the cost competitiveness equal to or higher than those in Western Europe. Other products, although the variable cost is very low, result in high production cost because the fixed cost reaches 1.4 to 1.9 times that in Western Europe, due to high interest and construction cost as well as low production scale. This comparison is based on the same up-to-date plants in both areas.

However, small and old plants still exists in Western Europe, and the production cost of such plant will influence to the market price. Thus, the difference between both areas will decrease.

When comparing products substituting for imported ones, the factors that increase the cost, such as freight and import duty are included. Substantially, therefore, the realization for a new project might be possible as far as the domestic demand is balanced with the economical production scale. From this discussion, the prospective products are classified into the following two groups.

1) Products having potentials for export: MTBE, methanol, and urea

2) Products forcussing alternation of import: ethylene, polypropylene, acrylonitrile, octanol, DMT, and ammonia

2-5-3 Preliminary Calculation of Profitability of Selected Products

Return on investment (ROI) for 9 products are calculated preliminarily by comparison between production cost and market prices in Argentina. When the market price of some product is not clear, the price for calculation is determined as follows:

- Products substituting for import

(Market price) = (Market price in the USA) + (Freight to Argentina) + (Import duty ; 10%)

- Products to be exported

(Market price) = (Market price in the USA) - (Freight to the USA)

Table III-2-36 shows the result of the calculation based on the assumptions mentioned in the previous sections and the assumption of 80% plant utilization. It should be noted that the price of ammonia and

Table III-2-35 Results of Cost Calculation

(US$/t)

	Item of Cost	Argentina	W Europe	Saudi Arabia	Capacity 1,000t/y		Investment Million US$
1,Ethylene (Ethane)	Variable Cost	85.2		45.2	A	200	199.50
	Fixed Cost + R O I	471.0		415.8	WE	---	-----
	Production Cost	556.2		461.1	SA	450	335.00
2,Ethylene (Naphtha)	Variable Cost	26.8	139.5		A	200	243.00
	Fixed Cost + R O I	573.8	295.8		WE	450	307.50
	Production Cost	600.6	435.3		SA	---	-----
3,Polypropylene	Variable Cost	162.3	348.0	267.6	A	40	36.00
	Fixed Cost + R O I	457.6	248.0	318.1	WE	100	52.50
	Production Cost	619.9	596.0	585.7	SA	100	68.25
4,Acrylonitorile	Variable Cost	334.1	561.8	389.7	A	50	84.00
	Fixed Cost + R O I	794.0	430.0	581.9	WE	100	94.00
	Production Cost	1128.1	991.8	971.6	SA	100	135.00
5,Octanol	Variable Cost	302.8	551.7	325.7	A	50	84.00
	Fixed Cost + R O I	795.5	543.3	728.5	WE	50	61.50
	Production Cost	1098.3	1095.0	1054.2	SA	50	84.00
6,DMT	Variable Cost	230.3	339.2	194.8	A	45	52.50
	Fixed Cost + R O I	549.4	300.7	397.7	WE	100	67.50
	Production Cost	779.7	639.9	592.5	SA	100	91.50
7,MTBE	Variable Cost	163.7	233.5	193.5	A	38	7.95
	Fixed Cost + R O I	99.3	53.4	68.2	WE	100	12.15
	Production Cost	263.0	286.9	261.7	SA	100	15.75
8,Methanol	Variable Cost	15.2	82.0	14.8	A	680	297.00
	Fixed Cost + R O I	205.9	151.9	206.6	WE	500	175.50
	Production Cost	221.1	233.9	221.4	SA	500	240.00
9,Ammonia	Variable Cost	18.3	78.3	15.7	A	300	157.50
	Fixed Cost + R O I	247.9	149.6	193.8	WE	500	172.50
	Production Cost	266.2	227.9	209.5	SA	500	225.00
10,Urea	Variable Cost	213.5	341.9	171.8	A	450	115.50
	Fixed Cost + R O I	121.1	78.3	107.3	WE	500	90.00
	Production Cost	334.6	420.2	279.1	SA	500	124.50

Note: A; Argentina
WE; Western Europe
SA; Saudi Arabia

Table III-2-36 Profitability of Selected Products (Preliminary)

	Production Cost (US$/t)	Estimated Domestic Market Prices (US$/t)	Profit (US$ million /Y)	ROI (%/year)
Ethylene	369.2	422	8.45	4.2
Polypropylene	451.1	1,000	17.6	48.9
Acrylonitrile	814	1,100	11.4	13.6
Octanol	787.8	980	7.68	9.1
DMT	567.6	840	9.81	18.7
MTBE	223.8	250	0.80	10.1
Methanol	139.2	180	22.2	7.5
Ammonia	167.8	250	19.7	12.5
Urea	286	340	19.4	16.8

urea are based on the theoretical factory price in the USA. The price of other products are market price.

On the basis of preliminary assumptions mentioned above, evaluation of individual products has been attempted here.

(1) Overall evaluation

1) Influence of the utilization factor

In former calculation, utilization factor was constant with 80%. To analyse the influence of the utilization factor, the following assumptions are introduced for analysis of additional 10% of the factor.

Case 1 Additional 10% is for domestic consumption (at market price in Argentina)

Case 2 Additional 10% is for export (at exporting price in Argentina)

The results are shown in Table III-2-37. As a result, the effect of 10% raising up improves the feasibility of all the products except for ethylene in good position. Moreover, the export for raising up the utilization factor is also effective.

2) Influence of the production capacity

Production capacity are enlarged as follows, except for octanol, methanol, ammonia and urea reaching economical scale, to evaluate the influence of the capacity.

Ethylene	;	200,000 ⟶ 300,000 t/y
Polypropylene	;	40,000 ⟶ 60,000 t/y
Acrylonitrile	;	50,000 ⟶ 80,000 t/y
DMT	;	45,000 ⟶ 60,000 t/y
MTBE	;	38,000 ⟶ 60,000 t/y

Table III-2-38 shows the result on the basis of 80% utilization factor. The table shows the enlargement of production capacity is effective, and it should be considered to enlarge the capacity as far as the investment capital, market and raw material allows.

Table III-2-37 Profitability at Operation Rate of 90% (Preliminary)

	Production Cost	Estimated Sale Prices		ROI	
	(US$/t)	Domestic (US$/t)	Export (US$/t)	Case 1 %/year	Case 2 %/year
Ethylene	337.6	422	250	7.6	5.9
Polypropylene	419	1,000	680	58.1	54.6
Acrylonitrile	759.8	1,100	650	18.2	15.5
Octanol	733.9	980	500	13.2	10.3
DMT	530.1	840	600	23.9	21.8
MTBE	217.1	-	250	-	14.2
Methanol	125.4	-	180	-	11.3
Ammonia	151.2	250	70	16.9	13.5
Urea	278.1	340	170	21.7	15.1

Table III-2-38 Sensitivity of Production Scale

	Production Cost		ROI	
	Original US$/t	Enlarged US$/t	Original %/year	Enlarged %/year
Ethylene	369.2	335.4	4.2	7.9
Polypropylene	451.1	416.6	48.9	58.7
Acrylonitrile	814	749.3	13.6	19.2
DMT	567.6	537.8	18.7	22.7
MTBE	223.8	216.6	10.1	14.4

(2) Evaluation of individual products

1) Ethylene

The fixed cost for ethylene is high, reflecting the small scale and high investment cost. It is important to enlarge the production capacity and raise the utilization factor introducing export of ethylene and its derivatives, thus the fixed cost could be reduced.

When compared the raw material of ethane with naphtha, ethane cracker seems better through the calculation. In the case of naphtha cracker, however, there are various byproducts, propylene, C_4 fraction, and pyrolysis gasoline, etc., the competition between two raw materials might be reversible depending on pricing of these byproducts. Moreover, the variable cost for naphtha is much cheaper than that of ethane. If the fixed cost could be reduced by above countermeasure, naphtha cracker may have a potential for higher competitiveness than ethane cracker.

2) Polypropylene

The profitability of polypropylene is very high, when utilize propylene recovered from FCC off gas. Therefore, the promotion of new project is reasonable considering the possibility of export. Other new projects except for Petroquimica Cuyo, may have potentials for project implementation as far as propylene from FCC is available.

Some projects utilizing dehydrogenated propylene from cheap propane may also have possibility for project realization.

3) Acrylonitrile

Substitution of imported AN is feasible when utilize the propylene from FCC. Partial export of surplus products should be taking into account for enlargement of production capacity and raising the utilization factor, aiming at reduction of the fixed cost. It is not feasible to utilize dehydrogenated propylene.

4) Octanol

In the case of octanol, feasibility is very limited only for utilizing propylene from FCC, substitution of imported product and partial export for raising utilization factor. It can not be feasible to utilize dehydrogenated propylene.

5) DMT

DMT project of PGM is feasible on the basis of price for captive use of o-Xylene. Even in this case, it should be studied to enlarge the production capacity and raise the operation rate.

6) MTBE

It is feasible to utilize iso-butylene recovered from FCC off gas. The project of MTBE should be export-oriented one. It should be considered to enlarge the capacity and raise the utilization factor as far as exporting market and raw materials are available.

7) Methanol

Currently, there is oversupply in the world and the market situation is not favorable for new projects. As a result, even if a large plant with high operation rate could be achieved, the feasibility are not good. Therefore, project implementation will be realized after oil situation could be settled.

8) Ammonia and urea

With the provision of recovery of international market, it will be feasible on the basis of countermeasures for capacity enlargement, substitution for imported product and marginal export for raising operation rate. To improve the economy of the project, a large plant, instead of several small plants, should be installed.

2-6 Preliminary Master Plan for Future Development of Argentine Petrochemical Industry

2-6-1 Location and Production Capacity

Master plan is classified into three stages: First Phase (by 1987), Second Phase (1988-1990) and Third Phase (after 1991).

(1) First Phase

1) Bahia Blanca

Revamping of ethylene plant by PBB: 200,000 → 245,000 t/y

New plants by INDUPA group:

HDPE	32,000 t/y
VCM	130,000 t/y
PVC	58,000 t/y

2) Santa Fe

Revamping of SM plant by PASA: 54,000 → 65,000 t/y

Revamping of ethylene plant by DUPERIAL: 15,000 → 22,000 t/y

(2) Second Phase

1) Bahia Blanca

New ethylene plant by PBB: More than 200,000 t/y
(Detailed study on raw materials and new products is necessary)

New PVC plant by ELECTROCLOR: 70,000 t/y

New products corresponding to the new ethylene plant

2) Ensenada

There are projects by PGM already, additional study for enlargement of production capacity, aiming at improvement of economy, may be necessary.

New oxo alcohols plant	more than 35,000 t/y
New MTBE plant	more than 38,000 t/y
New butene-1 plant	more than 25,000 t/y
New DMT plant	more than 45,000 t/y
New PET (GT) plant	12,000 t/y
New PET (GE) plant	5,000 t/y

3) Mendoza

New FCC unit 21,000 BD
New polypropylene plant by Petroquimica Cuyo: 40,000 t/y

(3) Third Phase

1) Location available for FCC propylene (Ensenada and Mendoza)

New AN plant	more than 50,000 t/y
New octanol plant	more than 50,000 t/y
New polypropylene plant	more than 50,000 t/y

2) Location available for cheap propane and butane (Neuquen Province and others)

New polypropylene plant	50,000 t/y
New MTBE plant	more than 50,000 t/y
New butene-1 plant	more than 30,000 t/y
Other propylene derivatives plan	
Other C_4 derivatives plant	

3) Location producing natural gas with convenient transportability

New methanol plant	more than 500,000 t/y
New ammonia plant	more than 300,000 t/y
New urea plant	more than 300,000 t/y

2-6-2 Investment Cost and Start-up Year

The investment cost and timing of completion of each selected products in Second and Third Phase are shown in Table III-2-39. The investment cost excludes the cost of preparation for infrastructure because it is fluctuating widely location by location. The investment cost are calculated on the basis of prices in June 1986.

Total investment cost in Second Phase
US$432.25 + α million ___ US$475.75 + α million

Total investment cost in Third Phase
US$862.4 + ß million

2-6-3 Measures for Realization of Development Plan

As stated in the previous sections the products adopted in Second Phase and Third Phase have cost competitiveness with imported products in the domestic market. Among these products, only methanol, urea and MTBE have cost competitiveness in the exporting market. The following measures are necessary to realize the development plans.

(1) Products substituting for import

Ethylene derivatives, polypropylene, acrylonitrile, octanol and DMT are classified in this category.

1) The ratio of domestic demand to production capacity should be high enough, more than 70% is favorable in general.

Table III-2-39 Preliminary Master Plan: Investment Costs and Starting-up Year of Second Phase and Third Phase Development Plan

(US$ million, 1,000 t/y)

	Location	Investment		Starting up year
		Invs't cost	Capacity	
Second Phase				
1. Ethylene(Ethane)	Bahia Blanca	199.5	200	1990
1' Ethylene(Naphtha)	↓	243	200	
2. P V C		91	70	1990
3. New Products	↓	?	?	1990
4. Oxoalcohol	Ensenada	?	35	1988
5. M T B E	↓	7.95	38	1988
6. Butene-1		27	25	1988
7. D M T		52.5	45	1988
8. P E T(GT)		18.3	12	1988
9. P E T(GB)	↓		5	1988
10. Polypropylene(1)	Mendoza	36	40	1989
Sub-total		432.25+α ~475.75+α		
Third Phase				
11. Acrylonitrile	Ensenada or Mendoza	84	50	1991
12. Octanol	↓	84	50	1991
13. Polypropylene(2)	↓	42	50	1992
14. Polypropylene(3)	Area with cheep	42	50	1995
15. M T B E	propane and butane	9.7	50	1995
16. Butene-1	↓	30.7	30	1995
17. Propylene Derivatives	↓	?	?	1995
18. C4 Derivatives	↓	?	?	1995
19. Methanol	Natural gas	297	680	1991
20. Ammonia	producing area	157.5	300	1991
21. Urea	↓	115.5	450	1991
Sub-total		862.4+β		
Total Investment Costs		1294.65+γ ~1338.15+γ		

2) If the net income from export is higher than variable cost, the export is considered effictive to raise the operation rate. In this case, however, the negotiation with foreign importers is necessary to obtain reasonable earnings.

3) The production capacity should be enlarged upto the size of domestic demand within the limit of availability of investment capital and raw materials. Project implementation is suggested to be postponed until the domestic demand is large enough to be economical plant scale.

4) It is important to make more efforts for rationalization, without depending on high rate of import duty, in order to maintain and improve international cost competitiveness in the future.

(2) Products to be exported

Methanol, urea and MTBE are classified in this category.

1) These are products having cost competitiveness. It is necessary to enlarge the production capacity as far as exporting market, investment capital and raw materials allow. The way to achieve this target is to find specific overseas customers and to introduce joint venture system with foreign investors.

2) These must be enough domestic market to secure reasonable price.

3) It is desirable to construct a large scale plant instead of several small plants as far as domestic market allows.

4) The export duty is suggested to be abolished to promote export.

2-6-4 Policies for Development of Petrochemical Industry

1) Promotional policy for investment

- Concrete guarantee for the prices of raw materials and energy.

- Protection for investors by means of exemption and deduction for corporate income tax and others.

- Provision of soft loan to the project having priority.

2) Establishment of stability and consistency of economic policy

- If the change of policy gives a severe influence on the project implementation which already started, the application of the changed policy to that project should be exempted.

3) Policy for export and import duties

a) Export duty

- Export duty for petrochemical products is recommended to be abolished as a general rule.

- Adequate export duty can be imposed to only for products having strong cost competitiveness.

b) Import duty

- Import duty for capital goods, and royalty for them which are not available in Argentina should be exempted.

- Import duty for petrochemical products which are produced by domestic producers should be reduced gradually to the suitable level in order to encourage rationalization of existing plants and development of domestic demand.

4) Promoting integral coordination by the government

- Among various projects for different products, the coordination of government is important to put priority on the basis of suitability in Argentine conditions.

- In the case of projects for same product, it is important that the government put priority on a large scale plant. Overall and precise feasibility study will be necessary to make good coordination.

5) Internationalization of Argentine petrochemical industry

- Internationalization of petrochemical industry will progress through export and import of petrochemical products.

  It is important to establish the system and organization to evaluate the informations about petrochemical market in the world especially in order to increase export.

- One of the reasonable way to get exporting market is to organize joint venture with an influencial petrochemical organization having its own market in the foreign market. The incentive policies should be introduced for its purpose.

6) Countermeasures to promote reduction of investment cost

- As for the priority projects, especially huge investment cost are necessary, the guideline for domestic portion of construction should be reconsidered through comparison of investment cost with full turn key method.

- Exemption and reduction of import duty for imported capital goods.

- Enlarging production capacity is indirect but effective method reduction of fixed cost.

2-7 Suggestions

As described in the previous sections, the selection of products with some prospects is discussed through the evaluation both of international market and Argentine situation of petrochemical industry. Moreover, the preliminary master plan for the development of Argentine petrochemical industry is shown on the basis of preliminary evaluation for profitability. In this section, we summarize the discussion in the previous sections and make some suggestions for the development of Argentine petrochemical industry.

(1) Necessity of intergrated sector policy

Under unstable oil market conditions, economical evaluation of new petrochemical projects is difficult. On the other hand, the world resources of hydrocarbons are limited. Thus petrochemical projects in resource-rich countries like Argentina will have potentiality in a long-run. There are a lot of new projects announced in Argentina. But these are not based on the integrated sector study. In order to promote the development of petrochemical industry, it is necessary to make the well coordinated plan for the industry. Rough idea about the sector study, a preliminary master plan and suggested policy are shown in the previous sections.

(2) Implementation plan

Outline of the plan for implementation will be as follows.

(a) Period up to 1990

Projects of prospective products located in the well prepared site are reconsidered from the various viewpoints.

- New Ethylene plant in Bahia Blanca: It should be included to study optimization for raw materials.
- New PVC plant in Bahia Blanca:
- New petrochemical products corresponding to the new ethylene plant in Bahia Blanca: It may be included to study derivatives of propylene, C_4's and aromatics corresponding to diversification for ethylene raw materials.
- Reevaluation of the projects by PGM in Ensenada: Reevaluation from the viewpoints of the market, production capacity and economy for the projects of Oxo-alcohols, MTBE, Butene-1, DMT and PET.

The polypropylene project of Petroquimica Cuyo is not necessary to be reconsidered, unless special change in conditions occurs.

(b) Period after 1991

New projects of prospective products located in the area having availability of cheap raw materials, including less prepared site, are evaluated in this plan.

- Location with propylene recovered from FCC (Ensenada or Mendoza)

  The project study is necessary to clarify the priority among the projects of Polypropylene, Acrylonitrile and Octanol.
  The detailed study of new project will be done based on the above result.

- Location with cheap propane and butane (Neuquen Province and others)

  The following projects are included, utilizing dehydrogenated propylene and C_4's (Butylenes and Butadiene) from cheap propane and butane.

  New polypropylene plant
  New MTBE plant
  New Butene-1 plant
  New plant of Propylene derivatives except for polypropylene
  New plant of C_4's derivatives except for MTBE and Butene-1

- Location producing natural gas with convenient transportability

  New large Methanol plant
  New large Ammonia and Urea plants

(3) Prospects of Argentine petrochemical products

a) Based on the analysis and evaluation of 65 petrochemical products, the following products are selected as the products with prospects:

   - Ethylene and its derivatives: Ethylene, HDPE, EDC, VCM, PVC

   - Propylene derivatives: Polypropylene, Acrylonitrile, Oxo-alcohols, Octanol

   - Aromatics derivatives: DMT

   - C_4's derivatives: MTBE

   - Natural gas derivatives: Methanol, Ammonia, Urea

b) The results of preliminary study on profitability of the petrochemical products are as follows:

   - Products with prospects: Polypropylene, Ammonia, Urea

   - Products with some prospects: Acrylonitrile, DMT, MTBE, HDPE, EDC, VCM, PVC

c) The followings are classification for exportability

   - Exportable products: MTBE, Methanol, Urea

   - Products mainly for domestic consumption: Ethylene, HDPE, EDC, VCM, PVC, polypropylene, Acrylonitrile, Oxo-alcohols, Octanol, DMT, Ammonia

d) Products to be studied in the medium- and long-term plans are as follows;

- Medium-term plan: Ethylene, PVC, Oxo-alcohols, MTBE, Butene-1, DMT, PET, Others

- Long-term plan: Acrylonitrile, Octanol, Polypropylene, MTBE, Butene-1, Propylene derivatives, C_4's derivatives, Methanol, Ammonia, Urea, Others

2-A Appendix

2-A-1 Location Map of Petrochemical Complex

2-A-2 Argentine Petrochemical Product Forecast

Table III-2-A1 Argentine Petrochemical Product Forecast (Case A)
Table III-2-A2 Argentine Petrochemical Product Forecast (Case B)
Table III-2-A3 Argentine Petrochemical Product Forecast (Case C)

Meanings of each line are as follows.

Line Number	
001 - 002	Argentine GNP
003	Argentine Population
004 - 008	Plastics for general purpose
010 - 012	Petrochemicals for synthetic fibre
014 - 016	Plastics for industrial purpose
018	Synthetic rubber
019 - 022	GNP per capita and Demand per capita
023 - 030	Shares in each group
031 - 034	Estimation of each group
035 - 076	Ethylene and its derivatives
077 - 092	Propylene and its derivatives
093 - 100	Benzene and its derivatives
101 - 117	Indices of products

Table III-2-A1 Argentine Petrochemical Product Forecast (Case A)

I D	C O N T E N T	U N I T	78	80	82	83	Rate %	84	85	86	87	88	89	90	91	92	93	94	95	83/78	95/85
001																					
*002	GNP dollar	BIL dollar	50.4	66.2	71.6	61.3	0.020	62.5	63.7	65.0	66.3	67.6	69.0	70.4	71.8	73.2	74.7	76.2	77.7	3.9	2.0
*003	Population	MIL	26.4	27.7	28.4	29.6	0.020	30.1	30.7	31.4	32.0	32.6	33.3	34.0	34.6	35.3	36.0	36.8	37.5	2.3	2.0
004	LDPE	thousand t	68.0	70.0	126.0	98.0														7.5	
005	HDPE	thousand t	13.0	23.0	26.0	28.0														16.5	
006	PVC	thousand t	37.0	54.0	55.0	76.0														13.6	
007	PN	thousand t	12.0	19.0	24.0	27.0														17.6	
008	G.P. Total	thousand t	130.0	166.0	231.0	223.0														11.3	
009																					
010	EG	thousand t	6.0	3.0	5.0	6.0														0.0	
011	AN	thousand t	8.0	10.0	15.0	16.0														14.8	
012	S.F Total	thousand t	14.0	13.0	20.0	22.0														9.4	
013																					
014	PS	thousand t	22.0	24.0	24.0	27.0														4.1	
015	ABS	thousand t	5.0	5.0	4.0	6.0														3.7	
016	M.P Total	thousand t	27.0	29.0	28.0	33.0														4.0	
017																					
018	SBR	thousand t	29.0	31.0	31.0	29.0														0.0	
019	GNP/POP	$/ person	1909	2389	2521	2070		2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	1.6	0.0
*019	G.P/POP	M ton/MIL	4.916	5.896	7.923	7.362		7.757	7.757	7.757	7.757	7.757	7.757	7.757	7.757	7.757	7.757	7.757	7.757	8.4	0.0
*020	S.F/POP	M ton/MIL	0.482	0.464	0.708	0.783		0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.805	0.805	10.1	0.0
*021	M.P/POP	M ton/MIL	0.875	1.091	0.963	0.960		1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.8	0.0
*022	SBR/POP	M ton/MIL	1.087	1.120	1.080	1.031		1.080	1.080	1.080	1.080	1.080	1.080	1.080	1.080	1.080	1.080	1.080	1.080	-1.0	0.0
*023	LDPE/G.P	Mton/Mton	0.523	0.421	0.545	0.439	-0.002	0.437	0.435	0.433	0.431	0.429	0.427	0.425	0.423	0.421	0.419	0.417	0.415	-3.4	-0.4
*024	HDPE/G.P	Mton/Mton	0.100	0.138	0.112	0.125	0.002	0.127	0.129	0.131	0.133	0.135	0.137	0.139	0.141	0.143	0.145	0.147	0.149	4.6	1.4
*025	PVC /G.P	Mton/Mton	0.284	0.325	0.238	0.313	-0.002	0.311	0.309	0.307	0.305	0.303	0.301	0.299	0.297	0.295	0.293	0.291	0.289	1.9	-0.6
*026	PP /G.P	Mton/Mton	0.092	0.114	0.103	0.121	0.002	0.123	0.125	0.127	0.129	0.131	0.133	0.135	0.137	0.139	0.141	0.143	0.145	5.5	1.4
*027	EG /S.F	Mton/Mton	0.428	0.230	0.250	0.272	0.002	0.274	0.276	0.278	0.280	0.282	0.284	0.286	0.288	0.290	0.292	0.294	0.296	-8.6	0.7
	AN /S.F	Mton/Mton	0.571	0.769	0.750	0.727	-0.002	0.725	0.723	0.721	0.719	0.717	0.715	0.713	0.711	0.709	0.707	0.705	0.703	4.9	-0.2
*029	PS /M.P	Mton/Mton	0.814	0.827	0.857	0.818	0.002	0.820	0.822	0.824	0.826	0.828	0.830	0.832	0.834	0.836	0.838	0.840	0.842	0.0	0.2
*030	ABS /M.P	Mton/Mton	0.185	0.172	0.142	0.181	-0.002	0.179	0.177	0.175	0.173	0.171	0.169	0.167	0.165	0.163	0.161	0.159	0.157	-0.3	-1.1
031	G.P Total	M ton	129.7	163.3	225.0	217.9		234.2	238.9	243.6	248.5	253.5	258.5	263.7	269.0	274.4	279.9	285.5	291.2	10.9	2.0
032	S.F Total	M ton	12.7	12.8	20.1	23.1		24.3	24.8	25.3	25.8	26.3	26.8	27.3	27.9	28.5	29.0	29.6	30.2	12.7	2.0
033	M.P Total	M ton	23.1	30.2	27.3	28.4		30.7	31.3	31.9	32.6	33.2	33.9	34.6	35.3	36.0	36.7	37.4	38.2	4.2	2.0
034	SBR	M ton	28.7	31.0	30.6	30.5		32.6	33.2	33.9	34.6	35.3	36.0	36.7	37.4	38.2	38.9	39.7	40.5	1.2	2.0

Table III-2-A1 (Continued)

I D	C O N T E N T		U N I T	78	80	82	83	Rate %	84	85	86	87	88	89	90	91	92	93	94	95	83/78	95/85
035	LDPE	capacity	M ton	35.0	35.0	225.0	225.0		225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0		
035		demand	M ton	67.8	68.8	122.7	118.0		102.4	104.0	105.6	107.2	108.8	110.5	112.2	113.9	115.6	117.4	119.1	120.9	11.6	1.5
*036		import	M ton	37.0	38.0	9.0	1.3		1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	-48.8	-100.0
*037		export	M ton	0.0	0.0	23.0	66.8		57.8	65.0	72.0	79.0	86.0	92.0	97.0	105.0	102.8	98.0	94.0	92.0		3.5
038		product	M ton	30.8	30.8	136.7	183.0		136.5	168.0	176.6	185.2	193.8	201.5	208.2	218.9	217.6	215.4	213.1	212.9	42.7	2.3
039	HDPE	capacity	M ton	0.0	0.0	0.0	42.0		88.5	56.9	48.3	71.7	63.1	55.4	48.7	38.0	39.3	41.5	43.8	44.0		
039		demand	M ton	12.9	22.6	25.3	37.8		38.5	30.9	32.0	33.1	34.3	35.5	36.8	38.0	39.3	40.7	42.1	43.5	23.8	3.4
*040		import	M ton	13.0	23.0	25.0	29.8		23.3	12.0	6.0	3.0	2.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	18.0	-100.0
*041		export	M ton	0.0	0.0	0.0	9.0		6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
042		prduct	M ton	-0.0	-0.3	0.3	17.0		21.6	18.9	26.0	30.1	32.3	34.5	35.8	38.0	39.3	40.7	42.1	43.5	280.6	8.6
043	PVC	capacity	M ton				57.5		59.0	59.0	59.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0		
043		demand	M ton	36.9	53.1	53.5	70.9		69.1	74.0	75.0	76.0	77.0	78.0	79.1	80.1	81.2	82.2	83.3	84.4	13.9	1.3
*044		import	M ton	5.0	20.0	7.0	18.4		15.6	15.0	16.0	12.0	8.0	4.0	2.0	0.0	0.0	0.0	0.0	0.0	29.7	-100.0
*045		export	M ton	1.0	1.0	0.0	0.3		0.1	0.0	0.0	3.0	6.0	12.0	18.0	25.1	24.0	23.0	21.9	20.8		
046		prduct	M ton	32.9	34.1	46.5	52.8		53.6	59.0	59.0	67.0	75.0	86.0	95.1	105.3	105.3	105.3	105.3	105.3	9.8	5.9
047	EG	capacity	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
047		demand	M ton	5.4	2.9	5.0	6.3		7.9	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.5	8.7	8.9	2.9	2.7
*048		import	M ton	6.0	3.0	5.0	6.3		7.9	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.5	8.7	8.9	0.9	2.7
*049		export	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
050		product	M ton	-0.5	-0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-46.1	
051	PS	capacity	M ton	51.2	51.2	51.2	51.2		48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0		
051		demand	M ton	18.8	25.0	23.4	26.0		31.5	25.7	26.3	26.9	27.5	28.1	28.8	29.4	30.1	30.7	31.4	32.1	6.6	2.2
*052		import	M ton	0.0	3.0	1.0	0.7		3.1	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0		-100.0
*053		export	M ton	0.0	0.0	0.0	1.2		0.9	3.0	5.0	7.0	9.0	11.0	13.0	13.7	13.0	12.4	11.7	11.0		13.8
054		prduct	M ton	18.8	22.0	22.4	26.5		29.3	27.7	30.3	32.9	35.5	38.1	40.8	43.2	43.2	43.2	43.2	43.2	7.0	4.5
055	ABS	capacity	M ton				6.0		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0		
055		demand	M ton	4.2	5.2	3.9	5.4		7.7	5.5	5.6	5.6	5.7	5.7	5.8	5.8	5.8	5.9	5.9	6.0	4.7	0.7
*056		import	M ton	1.0	1.0	1.0	0.4		0.0	2.0	2.0	2.0	2.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	-16.7	-100.0
*057		export	M ton	0.0	0.0	0.0	0.0		0.0	0.3	0.3	0.9	1.2	1.5	1.8	4.0	4.0	3.9	3.9	3.8		29.1
058		prduct	M ton	3.2	4.2	2.9	5.0		7.7	3.8	3.9	4.5	4.9	5.2	6.6	9.9	9.9	9.9	9.9	9.9	8.8	9.8
059	SBR	capacity	M ton	50.0	50.0	50.0	50.0		50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0		
059		demand	M ton	28.7	31.0	30.6	29.8		32.9	33.2	33.9	34.6	35.3	36.0	36.7	37.4	38.2	38.9	39.7	40.5	0.7	2.0
*060		import	M ton	5.0	3.0	3.0	1.1		0.6	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	-26.1	-100.0
*061		export	M ton	6.9	5.0	18.0	18.8		13.7	13.0	12.0	11.0	10.0	9.0	8.0	7.5	6.7	6.0	5.2	4.4	25.6	-10.1
062		prduct	M ton	29.7	33.0	45.6	47.5		46.0	45.2	44.9	44.6	44.3	44.0	43.7	45.0	45.0	45.0	45.0	45.0	9.8	-0.0
063	SM	capacity	M ton	54.0	54.0	54.0	54.0		54.0	54.0	54.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0		
063		demand	M ton	30.6	35.3	39.1	48.3		52.0	44.9	47.5	50.3	53.0	55.8	58.9	63.1	63.1	63.1	63.1	63.1	9.5	3.4
*064		import	M ton	0.0	0.0	0.0	0.0		1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*065		export	M ton	0.0	13.0	9.0	4.4		6.0	5.0	4.0	3.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0		-100.0
066		product	M ton	30.6	48.3	48.1	54.7		57.1	49.9	51.5	53.3	55.0	56.8	58.9	63.1	63.1	63.1	63.1	63.1	12.2	2.3
073	E	capacity	M ton	54.0	54.0	254.0	254.0		254.0	254.0	254.0	239.0	307.0	307.0	307.0	307.0	307.0	307.0	307.0	307.0		
073		demand	M ton	45.6	50.6	160.2	203.1		211.0	218.4	235.3	253.4	269.5	286.3	300.1	328.7	320.8	313.8	318.9	328.2	34.7	3.9
*074		import	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.7	13.8	12.8	11.9	13.2		
*075		export	M ton	0.0	0.0	20.0	45.0		46.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
076		product	M ton	45.6	50.6	180.2	248.1		257.0	218.4	235.3	253.4	269.5	286.3	300.1	307.0	307.0	307.0	307.0	307.0	48.2	3.4

Table III-2-A1 (Continued)

I D	C O N T E N T		U N I T	78	80	82	83	Rate %	84	85	86	87	88	89	90	91	92	93	94	95	83/78	95/85
077	PP	capacity	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	20.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0		
077		demand	M ton	11.9	18.6	23.3	25.9		32.5	29.8	30.9	32.0	33.2	34.4	35.6	36.8	38.1	39.4	40.8	42.2	16.6	3.5
*078		import	M ton	11.9	18.6	23.3	25.9		32.5	29.8	30.9	32.0	13.2	0.0	0.0	0.0	0.0	0.0	0.8	2.2	16.8	-22.7
*079		export	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
080		prduct	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	20.0	34.4	35.6	36.8	38.1	39.4	40.8	40.0	-100.0	
081	AN	capacity	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
081		demand	M ton	7.2	9.8	15.0	15.8		13.5	17.9	18.2	18.5	18.8	19.2	19.5	19.8	20.2	20.5	20.9	21.2	16.7	1.7
*082		import	M ton	7.2	9.8	15.0	15.8		13.5	17.9	18.2	18.5	18.8	19.2	19.5	19.8	20.2	20.5	20.9	21.2	17.0	1.7
*083		export	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
084		product	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-100.0	
085	IPA	capacity	M ton	35.0	35.0	35.0	35.0		35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0		
*085		demand	M ton	12.0	15.0	16.0	14.9		15.4	15.7	16.0	16.3	16.7	17.0	17.3	17.7	18.0	18.4	18.8	19.1	4.4	1.9
*086		import	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*087		export	M ton	1.0	5.0	16.0	14.2		17.0	16.5	16.0	15.5	15.0	14.5	14.0	13.8	13.5	13.1	12.7	12.4	79.0	-2.8
088		product	M ton	13.0	20.0	32.0	29.1		32.4	32.2	32.0	31.8	31.7	31.5	31.3	31.5	31.5	31.5	31.5	31.5	17.4	-0.2
089	P	capacity	M ton	42.0	42.0	62.0	62.0		148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8		
089		demand	M ton	5.4	9.7	18.4	16.0		17.6	18.3	18.2	18.0	41.8	61.6	63.2	65.3	67.2	69.2	69.9	69.9	23.9	14.3
*090		import	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*091		export	M ton	0.0	0.0	0.0	0.0		0.0	9.0	18.0	27.0	36.0	45.0	54.0	68.0	66.6	64.6	63.9	63.9		21.6
092		prduct	M ton	5.4	9.7	18.4	16.0		17.6	27.3	36.2	45.0	77.8	105.6	117.2	133.3	133.9	133.9	133.9	133.9	23.9	17.2
093	CX	capacity	M ton	42.0	42.0	42.0	42.0		42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0		
*093		demand	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*094		import	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*095		export	M ton	28.0	23.0	25.0	32.7		38.6	38.0	38.0	39.0	39.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	3.1	0.5
096		prduct	M ton	28.0	23.0	25.0	35.2		41.6	38.0	38.0	39.0	39.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	4.6	0.5
097	B	capacity	M ton	144.0	144.0	144.0	144.0		144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0		
097		demand	M ton	80.7	89.7	91.2	101.3		109.9	102.5	103.6	105.5	106.7	108.5	109.3	112.5	112.5	112.5	112.5	112.5	4.6	8.9
*098		import	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*099		export	M ton	59.0	67.0	68.0	65.0		59.6	55.0	50.0	45.0	40.0	35.0	30.0	17.0	17.0	17.0	17.0	17.0	1.9	-11.0
100		product	M ton	139.7	156.7	159.2	166.3		169.5	157.5	153.6	150.5	146.7	143.5	139.9	129.6	129.6	129.6	129.6	129.6	3.5	-1.9
101	LDPE / E		ton / ton	0.689	0.622	0.773	0.752		0.541	0.784	0.765	0.745	0.733	0.717	0.707	0.727	0.723	0.715	0.708	0.707		
102	HDPE / E		ton / ton	-0.000	-0.007	0.001	0.069		0.085	0.088	0.112	0.121	0.122	0.123	0.121	0.126	0.130	0.135	0.139	0.144		
103	PVC / E		ton / ton	0.360	0.337	0.129	0.106		0.104	0.135	0.125	0.132	0.139	0.150	0.158	0.171	0.171	0.171	0.171	0.171		
104	EG / E		ton / ton	-0.007	-0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
105	SM / E		ton / ton	0.188	0.267	0.074	0.061		0.062	0.064	0.061	0.058	0.057	0.055	0.054	0.057	0.057	0.057	0.057	0.057		
108	PP / P		ton / ton	0.014	0.009	0.004	0.000		0.000	0.000	0.000	0.000	0.262	0.328	0.369	0.282	0.290	0.300	0.304	0.304		
109	AN / P		ton / ton	0.816	0.909	0.805	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
110	IPA / P		ton / ton	1.783	1.535	1.303	1.363		1.378	0.882	0.662	0.529	0.305	0.221	0.280	0.177	0.176	0.176	0.176	0.176		
111	SM / B		ton / ton	0.180	0.253	0.248	0.269		0.276	0.259	0.274	0.290	0.307	0.324	0.345	0.399	0.399	0.399	0.399	0.399		
112	CX / B		ton / ton	0.186	0.136	0.146	0.196		0.228	0.224	0.230	0.240	0.247	0.259	0.265	0.287	0.287	0.287	0.287	0.287		
113	other/ B		ton / ton	0.633	0.610	0.605	0.533		0.495	0.515	0.495	0.468	0.445	0.416	0.388	0.313	0.313	0.313	0.313	0.313		
114	PS / SM		ton / ton	0.625	0.464	0.475	0.494		0.523	0.567	0.601	0.630	0.658	0.685	0.705	0.698	0.698	0.698	0.698	0.698		
115	ABS / SM		ton / ton	0.042	0.034	0.024	0.036		0.053	0.031	0.030	0.034	0.035	0.037	0.044	0.062	0.062	0.062	0.062	0.062		
116	SBR / SM		ton / ton	0.290	0.204	0.284	0.260		0.241	0.272	0.261	0.250	0.241	0.232	0.222	0.213	0.213	0.213	0.213	0.213		
117	Ethane		M ton	57.0	63.2	225.3	310.1		321.2	273.0	234.1	316.7	336.9	357.9	375.2	383.7	383.7	383.7	383.7	383.7		

Table III-2-A2 Argentine Petrochemical Product Forecast (Case B)

I D	C O N T E N T	U N I T	78	80	82	83	Rate %	84	85	86	87	88	89	90	91	92	93	94	95	83/78	95/85
001																					
*002	GNP dollar	BIL dollar	50.4	66.2	71.6	61.3	0.040	63.7	66.3	68.9	71.7	74.5	77.5	80.6	83.8	87.2	90.7	94.3	98.1	3.9	4.0
*003	Population	MIL	26.4	27.7	28.4	29.6	0.020	30.1	30.7	31.4	32.0	32.6	33.3	34.0	34.6	35.3	36.0	36.8	37.5	2.3	2.0
004	LDPE	thousand t	68.0	70.0	126.0	98.0														7.5	
005	HDPE	thousand t	13.0	23.0	26.0	28.0														16.5	
006	PVC	thousand t	37.0	54.0	55.0	70.0														13.6	
007	PN	thousand t	12.0	19.0	24.0	27.0														17.6	
008	G.P Total	thousand t	130.0	166.0	231.0	223.0														11.3	
009																					
010	EG	thousand t	6.0	3.0	5.0	6.0														0.0	
011	AN	thousand t	8.0	10.0	15.0	16.0														14.8	
012	S.F Total	thousand t	14.0	13.0	20.0	22.0														9.4	
013																					
014	PS	thousand t	22.0	24.0	24.0	27.0														4.1	
015	ABS	thousand t	5.0	5.0	4.0	6.0														3.7	
016	M.P Total	thousand t	27.0	29.0	28.0	33.0														4.0	
017																					
018	SBR	thousand t	29.0	31.0	31.0	29.0														0.0	
019	GNP/POP	$/ person	1909	2389	2521	2070		2111	2152	2195	2238	2282	2326	2372	2418	2466	2514	2564	2614	1.6	1.9
*019	G.P/POP	M ton/MIL	4.916	5.896	7.923	7.362		7.897	8.039	8.184	8.332	8.482	8.635	8.790	8.949	9.110	9.274	9.442	9.612	8.4	1.8
*020	S.F/POP	M ton/MIL	0.482	0.464	0.708	0.783		0.821	0.837	0.853	0.870	0.887	0.904	0.921	0.939	0.958	0.976	0.995	1.014	10.1	1.9
*021	M.P/POP	M ton/MIL	0.875	1.091	0.963	0.960		1.042	1.067	1.092	1.118	1.144	1.172	1.200	1.228	1.257	1.287	1.318	1.349	1.8	2.3
*022	SBR/POP	M ton/MIL	1.087	1.120	1.080	1.031		1.098	1.116	1.135	1.154	1.173	1.192	1.212	1.232	1.253	1.274	1.295	1.317	-1.0	1.6
*023	LDPE/G.P	Mton/Mton	0.523	0.421	0.545	0.439	-0.002	0.437	0.435	0.433	0.431	0.429	0.427	0.425	0.423	0.421	0.419	0.417	0.415	-3.4	-0.4
*024	HDPE/G.P	Mton/Mton	0.100	0.138	0.112	0.125	0.002	0.127	0.129	0.131	0.133	0.135	0.137	0.139	0.141	0.143	0.145	0.147	0.149	4.6	1.4
*025	PVC /G.P	Mton/Mton	0.284	0.325	0.238	0.313	-0.002	0.311	0.309	0.307	0.305	0.303	0.301	0.299	0.297	0.295	0.293	0.291	0.289	1.9	-0.6
*026	PP /G.P	Mton/Mton	0.092	0.114	0.103	0.121	0.002	0.123	0.125	0.127	0.129	0.131	0.133	0.135	0.137	0.139	0.141	0.143	0.145	5.5	1.4
*027	EG /S.F	Mton/Mton	0.428	0.230	0.250	0.272	0.002	0.274	0.276	0.278	0.280	0.282	0.284	0.286	0.288	0.290	0.292	0.294	0.296	-8.6	0.7
	AN /S.F	Mton/Mton	0.571	0.769	0.750	0.727	-0.002	0.725	0.723	0.721	0.719	0.717	0.715	0.713	0.711	0.709	0.707	0.705	0.703	4.9	-0.2
*029	PS /M.P	Mton/Mton	0.814	0.827	0.857	0.818	0.002	0.820	0.822	0.824	0.826	0.828	0.830	0.832	0.834	0.836	0.838	0.840	0.842	0.0	0.2
*030	ABS /M.P	Mton/Mton	0.185	0.172	0.142	0.181	-0.002	0.179	0.177	0.175	0.173	0.171	0.169	0.167	0.165	0.163	0.161	0.159	0.157	-0.3	-1.1
031	G.P Total	M ton	129.7	163.3	225.0	217.9		238.4	247.5	257.0	266.9	277.2	287.8	298.9	310.3	322.2	334.6	347.5	360.8	10.9	3.8
032	S.F Total	M ton	12.7	12.8	20.1	23.1		24.8	25.7	26.8	27.8	28.9	30.1	31.3	32.5	33.8	35.2	36.6	38.1	12.7	3.9
033	M.P Total	M ton	23.1	30.2	27.3	28.4		31.4	32.8	34.3	35.8	37.4	39.0	40.8	42.6	44.4	46.4	48.5	50.6	4.2	4.4
034	SBR	M ton	28.7	31.0	30.6	30.5		33.1	34.3	35.6	36.9	38.3	39.7	41.2	42.7	44.3	45.9	47.6	49.4	1.2	3.6

Table III-2-A2 (Continued)

I D	C O N T E N T		U N I T	78	80	82	83	Rate %	84	85	86	87	88	89	90	91	92	93	94	95	83/78	95/85
035	LDPE	capacity	M ton	35.0	35.0	225.0	225.0		225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0	225.0		
035		demand	M ton	67.8	68.8	122.7	118.0		102.4	107.8	111.4	115.1	119.0	123.0	127.1	131.4	135.8	140.3	145.0	149.9	11.6	3.3
*036		import	M ton	37.0	38.0	9.0	1.3		1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	-48.8	-100.0
*037		export	M ton	0.0	0.0	23.0	66.8		57.8	61.0	64.0	67.0	71.0	74.0	78.0	81.0	75.0	69.0	60.0	52.0		-1.5
038		product	M ton	30.8	30.8	136.7	183.0		136.5	167.8	174.4	181.1	189.0	196.0	204.1	212.4	210.8	209.3	205.0	201.9	42.7	1.8
039	HDPE	capacity	M ton	0.0	0.0	0.0	42.0		88.5	57.1	50.5	75.8	67.9	60.9	52.8	44.5	46.1	47.6	51.9	55.0		
039		demand	M ton	12.9	22.6	25.3	37.8		38.5	32.0	33.8	35.6	37.5	39.5	41.7	43.9	46.2	48.7	51.2	53.9	23.8	5.3
*040		import	M ton	13.0	23.0	25.0	9.0		23.3	12.0	6.0	3.0	2.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	-7.0	-100.0
*041		export	M ton	0.0	0.0	0.0	0.0		6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
042		prduct	M ton	-0.0	-0.3	0.3	17.0		21.6	20.0	27.8	32.6	35.5	38.5	40.7	43.9	46.2	48.7	51.2	53.9	280.6	10.3
043	PVC	capacity	M ton				57.5		59.0	59.0	59.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0		
043		demand	M ton	36.9	53.1	53.5	70.9		69.1	76.7	79.1	81.6	84.2	86.9	89.6	92.4	95.3	98.3	101.4	104.6	13.9	3.1
*044		import	M ton	5.0	20.0	7.0	18.4		15.6	17.7	20.1	16.0	12.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	29.7	-100.0
*045		export	M ton	1.0	1.0	0.0	0.3		0.1	0.0	0.0	3.0	6.0	8.0	10.0	12.8	9.9	6.9	3.8	0.6		
046		prduct	M ton	32.9	34.1	46.5	52.8		53.6	59.0	59.0	68.6	78.2	86.9	99.6	105.3	105.3	105.3	105.3	105.2	9.8	5.9
047	EG	capacity	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
047		demand	M ton	5.4	2.9	5.0	6.3		7.9	7.1	7.4	7.8	8.1	8.5	8.9	9.4	9.8	10.3	10.7	11.3	2.9	4.7
*048		import	M ton	6.0	3.0	5.0	6.3		7.9	7.1	7.4	7.8	8.1	8.5	8.9	9.4	9.8	10.3	10.7	11.3	0.9	4.7
*049		export	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
050		product	M ton	-0.5	-0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-100.0	
051	PS	capacity	M ton	51.2	51.2	51.2	51.2		48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0		
051		demand	M ton	18.8	25.0	23.4	26.0		31.5	32.0	33.2	34.6	35.9	37.4	38.9	40.5	42.2	43.9	45.7	47.6	6.6	4.0
*052		import	M ton	0.0	3.0	1.0	0.7		3.1	2.0	2.0	2.0	2.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0		-100.0
*053		export	M ton	0.0	0.0	0.0	1.2		0.9	2.0	3.0	4.0	5.0	6.0	7.0	2.6	0.9	0.0	0.0	0.0		-100.0
054		prduct	M ton	18.8	22.0	22.4	26.5		29.3	32.0	34.2	36.6	38.9	41.4	44.9	43.2	43.2	43.9	45.7	47.6	7.0	4.0
055	ABS	capacity	M ton				6.0		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0		
055		demand	M ton	4.2	5.2	3.9	5.4		7.7	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.5	9.7	9.9	4.7	2.4
*056		import	M ton	1.0	1.0	1.0	0.4		0.0	2.0	2.0	2.0	2.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	-16.7	-100.0
*057		export	M ton	0.0	0.0	0.0	0.0		0.0	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.6	0.3	0.1	-0.0		-7.8
058		prduct	M ton	3.2	4.2	2.9	5.0		7.7	6.0	6.3	6.6	6.9	7.2	8.5	9.9	9.9	9.9	9.9	9.9	8.8	5.0
059	SBR	capacity	M ton	50.0	50.0	50.0	50.0		50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0		
059		demand	M ton	28.7	31.0	30.6	29.8		32.9	34.3	35.6	36.9	38.3	39.7	41.2	42.7	44.3	45.9	47.6	49.4	0.7	3.6
*060		import	M ton	5.0	3.0	3.0	1.1		0.6	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	-26.1	-100.0
*061		export	M ton	6.0	5.0	18.0	18.8		13.7	12.0	10.0	8.0	6.0	4.0	2.0	2.2	0.6	0.0	0.0	0.0	25.6	-100.0
062		prduct	M ton	29.7	33.0	45.6	47.5		46.0	45.3	44.6	43.9	43.3	42.7	42.2	45.0	45.0	45.9	47.6	49.4	9.8	8.8
063	SM	capacity	M ton	54.0	54.0	54.0	54.0		54.0	54.0	54.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0		
063		demand	M ton	30.6	35.3	39.1	48.3		52.0	50.2	52.4	54.7	57.1	59.5	63.5	63.1	63.1	64.1	66.5	69.0	9.5	3.2
*064		import	M ton	0.0	0.0	0.0	0.0		1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*065		export	M ton	0.0	13.0	9.0	4.4		6.0	4.0	2.0	2.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0		-100.0
066		product	M ton	30.6	48.3	48.1	54.7		57.1	54.2	54.4	56.7	58.1	60.5	63.5	63.1	63.1	64.1	66.5	69.0	12.2	2.4
073	E	capacity	M ton	54.0	54.0	254.0	254.0		254.0	254.0	254.0	299.0	307.0	307.0	307.0	307.0	307.0	307.0	307.0	307.0		
073		demand	M ton	45.6	50.6	160.2	203.1		211.0	220.6	235.7	253.5	270.3	286.3	304.8	320.0	320.8	322.2	321.8	321.2	34.7	3.8
*074		import	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	13.8	15.2	14.0	14.2		
*075		export	M ton	0.0	0.0	20.0	45.0		46.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
076		product	M ton	45.6	50.6	180.2	248.1		257.0	220.6	235.7	253.5	270.3	286.3	304.8	307.0	307.0	307.0	307.0	307.0	40.2	3.3

Table III-2-A2 (Continued)

I D	C O N T E N T	U N I T	78	80	82	83	Rate %	84	85	86	87	88	89	90	91	92	93	94	95	83/78	95/85
077	PP capacity	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	20.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0		
077	demand	M ton	11.9	18.6	23.3	25.9		32.5	30.9	32.6	34.4	36.3	38.3	40.3	42.5	44.8	47.2	49.7	52.3	16.6	5.3
*078	import	M ton	11.9	18.6	23.3	25.9		32.5	30.9	32.6	34.4	16.3	0.0	0.3	2.5	4.8	7.2	9.7	12.3	16.8	-8.7
*079	export	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
080	prduct	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	20.0	38.3	40.0	40.0	40.0	40.0	40.0	40.0	-100.0	
081	AN capacity	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
081	demand	M ton	7.2	9.8	15.0	15.8		13.5	18.6	19.3	20.0	20.7	21.5	22.3	23.1	24.0	24.9	25.8	26.7	16.7	3.6
*082	import	M ton	7.2	9.8	15.0	15.8		13.5	18.6	19.3	20.0	20.7	21.5	22.3	23.1	24.0	24.9	25.8	26.7	17.0	3.6
*083	export	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
084	product	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-100.0	
085	IPA capacity	M ton	35.0	35.0	35.0	35.0		35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0		
*085	demand	M ton	12.0	15.0	16.0	14.9		15.4	16.0	16.7	17.3	18.0	18.7	19.5	20.3	21.1	21.9	22.8	23.7	4.4	4.6
*086	import	M ton	0.0	0.0	0.0	0.0		17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*087	export	M ton	1.0	5.0	16.0	14.2		32.4	15.0	14.0	13.0	12.0	11.0	9.0	11.2	10.4	9.6	8.7	7.8	70.0	-6.3
088	product	M ton	13.0	28.0	32.0	29.1		30.8	31.0	30.7	30.3	30.0	29.7	28.5	31.5	31.5	31.5	31.5	31.5	17.4	0.1
089	P capacity	M ton	42.0	42.0	62.0	62.0		148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8	148.8		
089	demand	M ton	5.4	9.7	18.4	16.0		17.6	17.4	17.2	16.9	40.2	65.4	66.6	69.9	69.9	69.9	69.9	69.9	23.9	14.9
*090	import	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*091	export	M ton	0.0	0.0	0.0	0.0		0.0	9.0	18.0	27.0	36.0	45.0	54.0	63.9	63.9	63.9	63.9	63.9		21.6
092	prduct	M ton	5.4	9.7	18.4	16.0		17.6	26.4	35.2	43.9	76.2	110.4	120.6	133.9	133.9	133.9	133.9	133.9	23.9	17.6
093	CX capacity	M ton	42.0	42.0	42.0	42.0		42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0		
*093	demand	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*094	import	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*095	export	M ton	28.0	23.0	25.0	32.7		38.6	38.0	38.0	39.0	39.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	3.1	0.5
096	prduct	M ton	28.0	23.0	25.0	35.2		41.6	38.0	38.0	39.0	39.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	4.6	0.5
097	B capacity	M ton	144.0	144.0	144.0	144.0		144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0	144.0		
097	demand	M ton	80.7	89.7	91.2	101.3		109.9	105.4	105.5	107.7	108.6	110.9	112.8	112.5	112.5	113.2	114.6	116.1	4.6	0.9
*098	import	M ton	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
*099	export	M ton	59.0	67.0	68.0	65.0		59.6	55.0	50.0	45.0	40.0	35.0	30.0	17.0	17.0	16.3	14.9	13.4	1.9	-13.1
100	product	M ton	139.7	156.7	159.2	166.3		169.5	160.4	155.5	152.7	148.6	145.9	142.8	129.6	129.6	129.6	129.6	129.6	3.5	-2.1
101	LDPE / E	ton / ton	0.689	0.622	0.773	0.752		0.541	0.775	0.754	0.728	0.713	0.698	0.683	0.705	0.700	0.695	0.681	0.670		
102	HDPE / E	ton / ton	-0.000	-0.007	0.001	0.069		0.085	0.092	0.120	0.131	0.134	0.137	0.136	0.145	0.153	0.161	0.170	0.179		
103	PVC / E	ton / ton	0.360	0.337	0.129	0.106		0.104	0.133	0.125	0.135	0.144	0.151	0.163	0.171	0.171	0.171	0.171	0.171		
104	EG / E	ton / ton	-0.007	-0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
105	SM / E	ton / ton	0.188	0.257	0.074	0.061		0.062	0.068	0.064	0.062	0.060	0.059	0.058	0.057	0.057	0.058	0.060	0.062		
108	PP / P -	ton / ton	0.014	0.009	0.004	0.000		0.000	0.000	0.000	0.000	0.267	0.353	0.338	0.304	0.304	0.304	0.304	0.304		
109	AN / P -	ton / ton	0.816	0.009	0.005	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
110	IPA / P	ton / ton	1.783	1.535	1.303	1.363		1.312	0.879	0.653	0.517	0.295	0.201	0.177	0.176	0.176	0.176	0.176	0.176		
111	SM / B	ton / ton	0.180	0.253	0.248	0.269		0.276	0.277	0.286	0.304	0.320	0.340	0.364	0.399	0.399	0.406	0.421	0.436		
112	CX / B	ton / ton	0.186	0.136	0.146	0.196		0.228	0.220	0.227	0.237	0.243	0.254	0.260	0.287	0.287	0.287	0.287	0.287		
113	other/ B	ton / ton	0.633	0.610	0.605	0.533		0.495	0.502	0.485	0.458	0.435	0.404	0.374	0.313	0.313	0.306	0.291	0.276		
114	PS / SM	ton / ton	0.625	0.464	0.475	0.494		0.523	0.602	0.642	0.658	0.684	0.697	0.721	0.698	0.698	0.698	0.701	0.704		
115	ABS / SM	ton / ton	0.042	0.034	0.024	0.036		0.053	0.044	0.046	0.046	0.047	0.047	0.053	0.062	0.062	0.061	0.059	0.057		
116	SBR / SM	ton / ton	0.290	0.204	0.284	0.260		0.241	0.251	0.246	0.232	0.223	0.211	0.199	0.213	0.213	0.214	0.214	0.214		
117	Ethane	M ton	57.0	63.2	225.3	310.1		321.2	275.7	294.6	316.9	337.9	357.8	381.0	383.7	383.7	383.7	383.7	383.7		