

CORCO AND THE PETROCHEMICAL INDUSTRY

July 3, 1986



CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
UNIVERSITY OF PUERTO RICO • U.S. DEPARTMENT OF ENERGY
G.P.O. BOX 3682, SAN JUAN, PUERTO RICO 00936

CORCO AND THE PETROCHEMICAL INDUSTRY

Rafael Luis Llompart
July 3, 1986

Table of Contents

	<u>Page</u>
I. Introduction	1
II. Economic and Industrial Development: Background	3
a. The Refining Industry in Puerto Rico	4
b. The Petrochemical Industry in Puerto Rico	10
c. Impact of Government Regulations	17
III. Current Situation	28
a. The Rise & Fall of CORCO	28
1. Dependence of Puerto Rico on Foreign Oil and Naptha	30
2. Power Cost and Service	33
3. Logistical Problems	33
4. Labor	34
5. Markets for Products	35
IV. Future Considerations	36
a. Biomass Feedstock to Be Produced Locally	37
b. Caribbean Basin Initiative	37
c. Puerto Rico Finance Position	41
d. Venezuela - Puerto Rico Petrochemical Conversations	43
V. Conclusion	44

I. INTRODUCTION

During the 1960's the Government of the United States in conjunction with the Government of Puerto Rico were directly responsible for the establishment in Puerto Rico of a refining industry and petrochemical complex. That is, in the early 1950's, Puerto Rico was largely underdeveloped. Its income levels were very low and unemployment rates were extremely high. To alleviate this deplorable situation, the Government of Puerto Rico conceived "Operation Bootstrap" a program of industrial and economic development which remains in effect today. The government agency with primary responsibility for Operation Bootstrap was the Economic Development Administration, known as Fomento. Fomento accorded priority to the industrial development (apparel, shoe, textile plants) and to the establishment of the refining industry as one of its initial undertakings. The refining industry would provide Puerto Rico both with fuel for manufacturing, transportation, agriculture, and the generation of electricity and with raw material for further industrial development. As a result of Fomento's efforts, Commonwealth Oil Refining Company (CORCO) and Caribbean Gulf Refining Company (Gulf) both constructed small refineries during the 1950's. (Subsequently, the CORCO and Gulf refineries underwent numerous expansions.)

On the other hand, the Mandatory Oil Import Program (MOIP) of the Federal Government had a greater impact on the

development of the refining and petrochemical industries in Puerto Rico than any other government program. As per President Johnson's Proclamation No. 3693 a firm which established petrochemical or refining operations in Puerto Rico was permitted (1) to obtain a ten-year allocation of imported crude and unfinished oils for use as a feedstocks and (2) to ship both petrochemicals and certain volumes of refined petroleum products from Puerto Rico to the mainland without regard to the firm's licensed import quota. The quotas for the shipment of refined products to the states were partially dependent on the amount of raw material allowed into Puerto Rico by oil import regulation No. 1.

Government actions were responsible for the establishment in Puerto Rico of almost 290,000 B/D of refining capacity and approximately 10 percent of the nations petrochemical capacity. However, the dramatic rise in foreign oil prices, the imposition of price controls on domestic crude oil, and the financial deterioration of Puerto Rico petroleum-petrochemical complex resulted in the shut down of major operations, drastic unemployment in an industrial area, and the end of an era for Puerto Rico.

Thus, this report presents a brief overview of Puerto Rico's petrochemical operations and CORCO. It is a summation of my experience with this industry thru 1983 with an insight into future energy-related consideration.

II. ECONOMIC AND INDUSTRIAL DEVELOPMENT: BACKGROUND

During the 1940's Puerto Rico was called the "poorhouse of the Caribbean". Poverty, unemployment, undernourishment, sickness, and despair were rampant. The economy was based upon agriculture and was concentrated upon the cultivation of sugar, tobacco and coffee.

An economic development program was established to alleviate this situation as it became known as "Operation Bootstrap". The program was quite successful; the Island's GNP rose from \$755 million in 1950 to over \$14.0 billion in recent years, an average annual growth of 8.3%.

The manufacturing sector was the driving force in this growth, with an annual growth rate of 13.7% between 1950 and 1980. The refining and petrochemical industries were the cornerstone of this development. The refining and petrochemical industries grew from a zero employment level to a peak employment of 7,766 workers in 1974, representing about 4% of total manufacturing employment.* However, experience has shown that one job in the refining-petrochemical sector supports three additional jobs within other sectors of the economy. Thus, the total contribution of the industry to the economy, in terms of employment, was 17,868 jobs.

This sector generated over \$1.8 billion indirect net income during 1980. This represented 37% of the entire net income generated in the manufacturing sector.

*Based on Fomento's industry profiles of the 1970's.

There is no doubt that the industry, both in terms of employment and net income, made a substantial contribution to the total economy of Puerto Rico.

A. The Refining Industry in Puerto Rico

The establishment of the petroleum industry in Puerto Rico was premised upon the ready availability of cheap foreign feedstock and access to mainland markets.

In late 1955, Gulf Oil started up the Island's first refinery with a capacity of ten thousand barrels per day. In January 1956, Commonwealth Oil Refining Company (CORCO) began operation of its 23,000 barrel per day refinery at Penuelas on the southwest coast of Puerto Rico. Both companies substantially expanded their operations. Gulf's crude oil capacity is about 40,000 barrels per day and CORCO's was 141,000 barrels per day of crude oil, plus 70,000 barrels per day of naphtha for petrochemical production. CORCO was the largest industrial enterprise in Puerto Rico. In 1971, Puerto Rico Sun Oil Company started up a 66,000 barrel per day refinery at Yabucoa in the southeast part of the Island. The facility has since been expanded to 85,000 barrels per day. Phillips produces some gasoline in Puerto Rico, but their facility is basically a petrochemical operation. Since 1971, there has been essentially no investment in petroleum refining in Puerto Rico.

The refining industry has always been dependent on imported crude oil. Naphtha, of course, must also be imported or produced locally from imported oil. Since the early 1970's, the refined product output has been adequate to meet Island requirements for all principal products, plus allowing for exports to the United States mainland and to foreign countries.

Detailed historical data for raw materials and refined products are available beginning in 1971; these are summarized in tables. The naphtha imports include that which is used for petrochemicals, as well as the material which ultimately goes into fuel products. (See Tables A and B). There has been a 60% reduction on imports of refining petrochemical feedstocks since 1973.

In addition to the imports shown in the preceding table, minor amounts of crude oil, gas condensate and naphtha, have been brought into Puerto Rico from the United States, including some Alaskan crude oil beginning in 1971.

Please note that production and disposition patterns for major refined products in Puerto Rico have changed significantly in recent years. This is due to the close down of CORCO's operations and the downstream petrochemical industries.

The following brief discussion provides overview of the development of each of the three refining companies in Puerto Rico.

TABLE A

PUERTO RICO IMPORTS OF REFINING/PETROCHEMICAL FEEDSTOCKS
(—Millions Barrels of Oil per year)

	<u>1971</u>	<u>1973</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Crude Oil											
From Venezuela	47.6	71.6	35.1	31.4	26.2	25.6	12.9	15.6	0.4	0.0	0.0
from other areas	-	6.3	48.0	46.5	51.1	43.6	56.1	43.0	34.3	32.6	36.2
Total	<u>47.6</u>	<u>77.9</u>	<u>83.1</u>	<u>77.9</u>	<u>77.3</u>	<u>69.2</u>	<u>59.0</u>	<u>48.6</u>	<u>34.7</u>	<u>32.6</u>	<u>36.2</u>
Naphtha											
Total	38.6	47.8	36.6	42.4	38.4	34.2	32.6	22.1	18.6	20.1	17.5
Grand Total	-	-	-	-	-	-	-	-	-	-	-
(Crude Oil + Naphtha)	<u>86.2</u>	<u>125.7</u>	<u>119.7</u>	<u>120.1</u>	<u>115.7</u>	<u>103.4</u>	<u>91.6</u>	<u>70.7</u>	<u>53.1</u>	<u>52.7</u>	<u>53.7</u>

Source: Puerto Rico Office of Energy

Summary:

- a. 55% reduction on crude oil imports between 1973-1984
- b. 60% reduction on crude oil and naphtha imports 1973-1984

Table B

Production/Consumption/Exports
of Major Refined Products
(Million Barrels per year)

	<u>1974</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
<u>Production</u>										
Gasoline	29.0	27.3	32.0	30.0	28.0	24.7	22.7	15.4	14.9	16.7
Middle Distillates	21.7	23.6	20.0	19.9	17.0	17.5	12.9	11.6	10.7	8.7
Residual Fuel Oil	<u>29.1</u>	<u>30.0</u>	<u>30.3</u>	<u>30.0</u>	<u>27.6</u>	<u>22.4</u>	<u>16.7</u>	<u>9.9</u>	<u>10.3</u>	<u>12.1</u>
TOTAL	79.8	80.9	82.3	79.9	62.6	64.6	52.3	36.9	35.9	37.5
<u>Local Consumption</u>										
Gasoline	13.6	15.1	15.8	16.8	16.7	16.3	15.6	15.3	15.7	16.0
Middle Distillates	6.6	6.7	6.0	7.5	5.2	6.0	5.6	4.5	4.0	4.4
Residual Fuel Oil	<u>29.8</u>	<u>25.9</u>	<u>28.7</u>	<u>29.2</u>	<u>28.2</u>	<u>26.7</u>	<u>24.2</u>	<u>21.8</u>	<u>22.3</u>	<u>22.7</u>
TOTAL	50.0	46.7	49.5	53.5	50.1	49.0	45.4	41.6	42.0	43.1
<u>Exports</u>										
Gasoline	16.7	14.0	18.2	16.1	16.0	14.1	12.0	7.9	5.3	5.4
Middle Distillates	11.7	12.4	13.6	12.2	12.1	11.2	7.5	8.5	7.8	5.7
Residual Fuel Oil	<u>3.2</u>	<u>6.8</u>	<u>3.4</u>	<u>2.7</u>	<u>3.2</u>	<u>3.2</u>	<u>1.1</u>	<u>0.5</u>	<u>0.1</u>	<u>0.1</u>
TOTAL	31.6	33.2	35.2	31.0	31.3	28.5	20.6	16.9	13.2	11.1

Source: Office of Energy

COMMONWEALTH OIL REFINING COMPANY

CORCO was incorporated in 1953 as a processing refiner, purchasing Venezuelan crude oil from international companies and reselling the refined products to those oil companies or their affiliates, or to others. It was the largest single industrial enterprise on the island and one of the largest independent petroleum refiners and petrochemical manufacturers in the world.

CORCO's first facility was a 23,000 barrels per day refinery brought on stream in 1956. By 1974, the original \$25 million investment had grown to almost \$500 million and refining capacity had increased to 141 thousand barrels per day. In addition, a large petrochemical complex (Commonwealth Petrochemicals, Inc.) had been established as well as several other subsidiary and joint venture operations in the petrochemical area. (These are detailed in the Petrochemical discussion).

CORCO was the primary supplier of a number of petroleum products consumed in Puerto Rico including 62 percent of the motor gasoline, 42 percent of the liquefied petroleum gas, 58 percent of middle distillates, and 50 percent of the residual fuel oil. Most of the residual fuel oil was sold to the Puerto Rico Electric Power Authority for electricity generation. About half of CORCO's crude oil was from Venezuela, and the remainder from a variety of sources, principally Africa and Mexico.

PUERTO RICO SUN OIL COMPANY

This company was wholly-owned subsidiary of the Sun Company, Inc., a major integrated oil company engaged in activities in all aspects of the petroleum industry. Sun began operations in Puerto Rico in 1971 and currently operates a refinery at Yabucoa with a capacity of approximately 85 thousand barrels per day.

The Sun refinery produces lubricating oils, naphtha, distillate, and residual fuel oils. Essentially all lubes are shipped to the United States East Coast. About half of the other products are also shipped to the East Coast and half consumed on the island. Residual fuel oil is sold to PREPA's Aguirre Station on the South Coast, and also goes into bunkers (ship fuel) markets.

CARIBBEAN GULF REFINING CORPORATION

Gulf built Puerto Rico's first refinery, a ten thousand barrels per day facility at Bayamon, near San Juan. The current capacity is forty thousand barrels per day.

The product slate is approximately 25 percent gasoline, 25 percent middle distillates, and 50 percent residual fuel oil. All of these products are consumed in Puerto Rico except for small amounts of distillate fuel oil shipped to the East Coast.

B. The Petrochemical Industry In Puerto Rico

This section constitutes an overview of petrochemical history and individual company operations in Puerto Rico. The intent is to provide background and understanding of how and why the industry got where it did and its importance to the economy of Puerto Rico.

History

The petrochemical industry in Puerto Rico expanded dramatically since its beginning, but was far short of the plans envisioned in the early 1970's. In several respects, petrochemical history parallels that of the refining industry; in many ways they are intricately interrelated.

Union Carbide Caribe became the first petrochemical producer in Puerto Rico when it began ethylene glycol production at Peñuelas in 1959. Feedstocks were supplied by the nearby CORCO refinery. Rapid, large scale development began in the mid-1960's, stimulated by the same incentives offered to the refining industry- access to low cost foreign feedstocks and broad tax exemptions.

During the late 1960's, Union Carbide made several major expansions in Puerto Rico, CORCO built a large aromatics (benzene, toluene, xylenes) facility and a number of large United States petrochemical companies invested on the island, both alone and in joint ventures. The period was characterized by expansionary, optimistic attitudes. The economy of

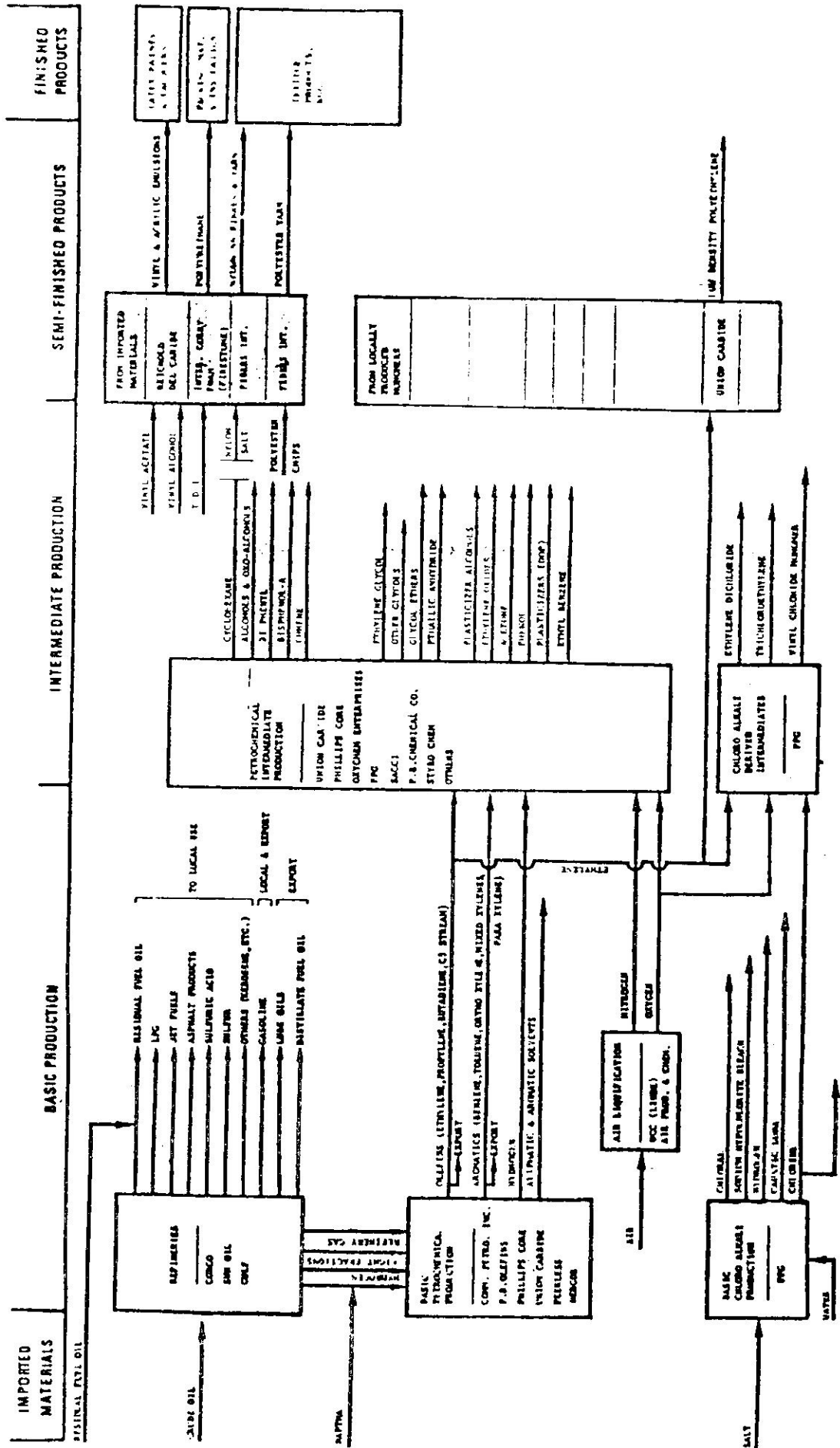
Puerto Rico was strongly stimulated, living standards on the island improved, and the companies involved anticipated high profit potentials.

In late 1973, the price of foreign crude oil and naphtha increased to levels above that of domestic feedstocks. Through a series of governmental regulations, primarily the Entitlements Program, Puerto Rican petrochemical producers were able to obtain naphtha, their primary feedstock, at prices essentially equal to those on the mainland. However, the primary original regulated advantage in a Puerto Rico location-low cost feedstock-was lost.

The timing of the increase in feedstock costs and subsequent uncertainties which halted petrochemical development was especially unfortunate. Through 1975, about 1.5 billion had been invested in petrochemical plants in Puerto Rico. This provided the facilities shown schematically in Figure 1, which is an accurate description of the situation prevailing in 1983 (except for the shutdown of various operations).

The unfortunate aspect was that the products produced in Puerto Rico were classified as basic or intermediate, and were almost totally shipped to the mainland for further processing into finished consumer items. Many of these were then imported into Puerto Rico. Original plans of Fomento and individual companies envisioned ambitious expansions into plastics, fibers, and other end products to utilize the products turned out by the core and satellite plants. These

REFINING AND PETROCHEMICAL INDUSTRY



downstream plants tend to be much more labor intensive and less polluting than the existing plants. Thus the Puerto Rican economy was the principal loser in the cancellation of these numerous expansions.

Naphtha was the basic feedstock for all petrochemical production in Puerto Rico. It was either imported or produced in island refineries from imported crude oil. Salt, the raw material for chlorine/caustic production was imported in solid form from the Bahamas. (On the Gulf Coast, salt was obtained from brine from underground wells, at a cost about forty percent less than in Puerto Rico).

The following brief discussions provide overviews of the development of each of the major petrochemical companies in Puerto Rico.

Union Carbide Caribe

Union Carbide was the first petrochemical producer in Puerto Rico. The initial ethylene/ethylene glycol plant at Peñuelas (1959) was expanded incrementally, an oxo-alcohol unit was added in 1965. A major expansion in ethylene and several new derivatives was brought on stream in 1971 with additional expansions throughout the decade. This represented an investment of \$300 million and increased employment to 1250. Most products were shipped to the United States, primarily to Union Carbide terminals on the East and Gulf Coasts. Feedstock was naphtha.

The following is a listing of the capacities of Union Carbide's major production units at Peñuelas. (Union Carbide shut down capacity for some of these products prior to 1983).

	<u>Million Pounds Per Year</u>
Ethylene	1,000
Propylene	500
Butadiene	185
Butaylenes	185
Ethylene Oxide	650
Ethylene Glycol	700
2 - Ethylhexanol	200
Low Density Polyethylene	310
Bisphenol - A	70
Glycol Ethers	240
Cumene	640
Phenol	200
Acetone	120
Butyraldehydes	160

Apart from petrochemicals, Union Carbide Grafito, Inc., produced graphite electrodes and Union Carbide Films-Packaging produced packaging products in Puerto Rico.

Commonwealth Petrochemicals, Inc. (CPI)

This company was CORCO's basic petrochemical operation, and came on stream in 1965 at the CORCO complex at Peñuelas. It was designed to send a mixed xylene stream to Hercor, a joint venture of CORCO and Hercules, which extracted ortho and paraxylene by crystalization and returned the residual to CPI. CPI could also convert its toluene to benzene.

After several expansions it was the largest aromatics facility in the world with the following capacities:

Benzene	-	170 Million Gallons
Toluene	-	10 Million Gallons
Xylenes	-	85 Million Gallons
Ortho-Xylene*	-	130 Million Gallons
Cyclohexane*	-	40 Million Gallons

Styrochem Corporation, wholly owned by CORCO, extracted ethylbenzene from mixed xylenes, but ceased operation because of adverse market conditions.

CPI's naphtha feedstock was from the CORCO refinery and also imported. The aromatics production was consumed on the island in other petrochemical production, and also exported. Benzene exports were particularly significant. Raffinate from the aromatics operation was supplied to Puerto Rico Olefins and to Oxochem Enterprise.

Puerto Rico Olefins (PRO)

This company was formed in 1971 as a joint venture between CORCO and PPG Industries. Naphtha from the CORCO refinery was the feedstock for the PRO plant which had an athylene capacity of 800 million pounds per year. Output was mostly used by PPG on their island operations. Butadiene was exported, and some streams were returned to the CORCO refinery.

*Produced by CORCO Cyclohexane, Inc.

PPC Industries Caribe

PPG began operations in Puerto Rico in 1971 with start up of a major petrochemical complex at Guayanilla. The principal products and capacities were:

Chlorine	-	520 Tons Per Day
Caustic Soda	-	587 Tons Per Day
Vinyl Chloride		
Monomer	-	500 Million Pounds Per Year
Ethylene Glycol	-	375 Million Pounds Per Year

A wide variety of other products were produced in minor amounts. Except for sales to Rico Chemical, all vinyl chloride monomer was moved to the East Coast in a ship built especially for PPG by Bethlehem Steel. Most other products were totally exported.

PPG imported solid salt for caustic/chlorine production, and received ethylene from jointly owned Puerto Rico Olefins.

Phillips Puerto Rico Core, Inc.

Phillips began operations in Puerto Rico in 1967 with an aromatics facility based on imported naphtha, mostly from Venezuela, at Guayama in the southeastern section of the island. Most aromatics products are exported to the United States Gulf and East Coasts. Raffinate is used in gasoline and/or sold to Union Carbide as ethylene feedstock. Phillips can produce about 25,000 barrels per day of gasoline.

Current capacities are:

Benzene	-	126 Million Gallons Per Year
Cyclohexane	-	98 Million Gallons Per Year
Toluene	-	110 Million Gallons Per Year
Mixed Xylenes	-	108 Million Gallons Per Year
Ortho-Xylene	-	250 Million Pounds Per Year
Para-Xylene	-	470 Million Pounds Per Year

These capacities are not additive since much of the products are partially consumed internally to produce others.

Following establishment of the aromatics facility, Phillips entered into an 80/20 joint venture with Rhone Poulenc in formation of Fibers International Corporation. The company produced nylon 66 and polyester fibers from imported nylon salt and polyester chips (original plans called for producing these materials on the Island). Fibers International has been sold to Chevron; polyester production has ceased, but polypropylene fiber production initiated from imported resin. In addition, there was a number of smaller downstream facilities based on output from the large plants.

C. Impact of Government Regulations

Government regulations influenced the establishment and development of refining and petrochemical industries in Puerto Rico.

Mandatory Oil Import Program (MOIP)

1. Quotas

The Voluntary Program for the restriction of oil imports into the United States (including Puerto Rico) was instituted in 1957. The program quickly proved ineffective and was replaced by the Mandatory Oil Import Program (MOIP) quota system in March 1959. Presidential Proclamation No. 3279, 24 Fed. Reg. 1781 (March 10, 1959). The MOIP initially provided historical importers, including those within Puerto Rico, with 80% of their last allocation under the Voluntary Program; the 80% figure was then reduced gradually.

The MOIP temporarily retarded the growth of the refining industry in Puerto Rico, as the Island's petroleum import quota levels were increased only by the amount necessary to accommodate increased demand in Puerto Rico and for exports from the United States. Thus, Puerto Rican refiners were not permitted to ship increased volumes of petroleum products to the mainland.

In 1965, the Federal Government acted to eliminate the obstacles to further economic development in Puerto Rico created by the MOIP. In that year, Secretary of Interior Udall recommended that President Johnson amend the MOIP in order to promote the development of the petrochemical industry in Puerto Rico as a means to: (1) stimulate the Puerto Rican economy and thereby provide vitally needed employment opportunities; and (2) expand the Puerto Rican refining industry without a corresponding

increase in volumes of petroleum products shipped to the mainland. On December 10, 1965, President Johnson issued Presidential Proclamation No. 3693, which implemented Secretary Udall's proposal.

Pursuant to Proclamation No. 3693, a firm which established petrochemical or refining operations in Puerto Rico was permitted: (1) to obtain a ten-year allocation of imported crude and unfinished oils for use as feedstocks; and (2) to ship both petrochemicals and certain volumes of refined petroleum products from Puerto Rico to the mainland without regard to the firm's licensed import quota. The feedstock cost advantage provided by a long-term allocation of foreign oil was approximately 40%, or \$1.25 per barrel; the right to ship a high value refined product such as gasoline to the mainland was actually worth approximately \$0.04 per gallon (\$1.68 per barrel). In return for preferred treatment under the MOIP, the following four refining and petrochemical firms agreed to invest substantial sums in Puerto Rican operations and to fulfill certain other obligations; Phillips Petroleum Corporation (Phillips, Commonwealth Oil Refining Company (CORCO), Puerto Rico Sun Oil Company (Sun) and Union Carbide Caribe, Inc. (Union Carbide).

As contemplated by the Federal and Puerto Rican Governments, the completion of a virtually self-contained refining and petrochemical industry in Puerto Rico would entail two stages of development. First, capital-intensive refineries and core petro-

chemical facilities were to be constructed to provide fuels, feedstocks and basic and intermediate petrochemicals. Second, employment expanding downstream facilities were to be built to process these products into high value consumer goods and other end products. The completion of the second stage was deemed particularly crucial to Puerto Rico's economic development because it would provide the vital employment opportunities necessary to reduce Puerto Rico's spiraling unemployment rates. (Even today, Puerto Rico's greatest assets, its plentiful human resources, are being wasted. Unemployment rates remain at approximately 20%).

2. Conversion of the MOIP from a Quota to a License Fee System

After review of the MOIP and its objectives, President Nixon issued Presidential proclamation No. 4210, which altered the MOIP by replacing the quotas with license fees which rose gradually between May 1, 1973 and May 1, 1975 to the level of \$0.21 per barrel for crude oil and \$0.63 for petroleum products. Fee-free licenses were issued to refiners and historical importers to the extent of their previous quotas under the MOIP. Proclamation No. 4210 scheduled those fee-free licenses for elimination by May 1, 1980. In addition, the long-term allocation of Phillips, CORCO, Sun, and Union Carbide were exempted from the payment of license fees.

The conversion of the long-term quota allocations into fee-free allocations, however, did not provide Puerto Rican

firms with the benefits previously received under the MOIP. While a quota allocation conferred a feedstock cost advantage of \$1.25 per barrel, a fee-free allocation of crude oil provided a maximum feedstock cost advantage of \$0.21 per barrel. A fee-free allocation of naphtha for use as petrochemical feedstock did not provide a Puerto Rican firm with any cost advantage over its mainland competitors because virtually all other domestic petrochemical manufacturers relied upon domestic feedstocks (primarily natural gas liquids) which were not subject to oil import license fees. By 1973, Puerto Rico's MOIP differential had ended considerably below \$1.25 per barrel.

Moreover, any feedstock cost advantage which Puerto Rican firms retained after the conversion of the MOIP from a quota to a license fee system became an extremely severe disadvantage as a result of the quadrupling of the price of imported crude oil and the imposition of price controls on domestic petroleum during the period of the Arab Embargo. Despite the belated attempts of the DOE to equalize crude oil and naphtha feedstock costs for all firms, firms operating in Puerto Rico continued to experience feedstock costs which were significantly higher than those of their mainland competitors. Thus, Puerto Rican firms did not receive the benefits intended by the grant of the long-term quota allocations under the MOIP.

According to a government official, in the summer of 1971, Puerto Rico was without an energy policy.* However, a strategy evolved which called for crude imports instead of product imports and for the participation of one or more crude producing countries in the supply and ownership of new crude processing capacity. This strategy was correct at the time because

1. Puerto Rico was importing 130,000 BCD of naphtha and was close to importing No. 6 fuel oil for PREPA and our cement plants.

2. OPEC power and petroleum prices were increasing, as was the risk of supply interruptions, but product markets, especially that for naphtha, were deteriorating more rapidly than crude markets. In particular, there had been two mini-energy crises: one caused by Lybia and Syria in the spring of 1970 and one by Venezuela, in December 1970. The latter lead to the near bankruptcy of CORCO and a change in its presidency.

3. The future dominance of petro-plastics over steel was already apparent, and so the "down-stream" employment potential of petrochemicals.

4. Neither technologically nor economically did we have the alternatives to petroleum which we have today. Our choices were basically limited to (a) no more economic growth, (b) import crude oil or (c) import products.

*Mr. Lewis Smith is at this time Director, Puerto Rico's Office of Energy.

The government official further stated that Puerto Rico's subsequent misfortunes in its energy and petrochemical fields were not due to its strategy, but to an unsuccessful implementation. Only a few individuals made sufficiently strong efforts to find permanent crude suppliers for our fledgeling petroleum and petrochemical industry. Basically, the handwriting was on the wall by May 1970, but too many thought that the world of \$2.00 crude oil would go on forever.

3. Results of Incentives Under Operation Bootstrap and the MOIP

As a consequence of the incentives offered by the Federal and Puerto Rican Governments pursuant to Operation Bootstrap and the MOIP, Puerto Rico developed a major refining and petrochemical industry. Puerto Rico's total refining capacity was 274 thousand barrels per day. The Puerto Rican location enabled refiners to supply significant volume of essential petroleum products to the East and Gulf Coast markets, as well as to Puerto Rico's 3.4 million inhabitants. Puerto Rico was ideally situated to receive crude oil from present and future sources of supply such as Africa, the Middle East, the North Sea, Venezuela, and Mexico. In addition, Puerto Rican refiners were capable of processing those heavy, high sulfur crudes which were in greatest supply and for which the least domestic refining capacity was presently available. Puerto Rico's refiners were also capable

of producing such high demand, valuable products as unleaded gasoline, jet fuel, naphtha, and various petrochemical feedstocks.

The Puerto Rican petrochemical industry represented approximately 9% of the total U.S. capacity. Puerto Rico had 15.7% of the total U.S. capacity for benzene production, 20.4% for paraxylene, 28.4% for cyclohexane, 32.2% for orthoxylene, 5.1% for ethylene, 6% for vinyl chloride monomer, and 15.8% for ethylene glycol.

The petroleum-petrochemical and allied products industries in Puerto Rico constituted one of the largest groups within Puerto Rico's manufacturing sector. The economic impact of these industries on our economy was estimated at more than \$300 million per year. Through 1975, approximately \$1.5 billion had been invested in petrochemical facilities in Puerto Rico. The replacement value of the facilities exceeded \$3 billion by 1980.

4. Adoption of Entitlements Program to Eliminate Cost Disparities

Subsequent to the imposition of price controls on domestic crude oil in 1973, and the conversion of the MOIP from a quota to a license fee system, it quickly became apparent that unless all refiners in the United States were provided access to low-cost old domestic crude oil, many would no longer be economically viable. Therefore, the Federal Energy Administration (FEA) adopted a crude oil cost

equalization program, commonly referred to as the Entitlements Program.

Although the inversion of foreign and domestic crude oil prices in late 1973 transformed the substantial feedstock cost advantage of Puerto Rican refining and petrochemical firms over similar firms on the mainland into a substantial and immediate disadvantage, the FEA did not implement the Entitlements Program until November 1974. CORCO alone estimates that its losses attributable to this period of delay were at least \$50 million.

Certain segments of the oil industry were granted special treatment under the Entitlements Program by the grant of access to the low-cost domestic oil in the same fashion that such segments had received disproportionate access to lower cost foreign oil under the MOIP quota system. Thus, the benefits formerly received by small refiners under the MOIP sliding scale quota allocation formula were restored by the FEA with the inclusion of a small refiner bias (SRB) in the Entitlements Program. In a similar fashion, the FEA and the DOE also reinstated the special treatment formerly received under the MOIP by importers of residual fuel oil into the East Coast market.

Despite the reinstatement under the Entitlements Program of the former MOIP benefits accorded small refiners and East Coast residual fuel oil importers, the FEA and the DOE failed to reinstate the benefits of Puerto Rican firms.

The failure of DOE and its predecessors either to equalize fully energy costs in Puerto Rico or to restore the affirmative energy cost advantage enjoyed under the MOIP quota system had a particularly devastating impact upon the Island's refiners and petrochemical manufacturers. Since 1973, no new refining or petrochemical facilities was built in Puerto Rico, and only a few minor expansions or conversion of existing facilities occurred which were not planned before 1973.

The Pace Company report entitled "Refining and Petrochemicals in Puerto Rico" (January 1979), and numerous other studies have confirmed that operating and transportation costs were substantially higher in Puerto Rico than on the mainland. The Pace report found that, for Puerto Rico's refiners and petrochemical manufacturers, electricity rates were 2.6 times, or \$59 million per year, higher than on the Gulf Coast; industrial fuel costs were double, or \$88 million per year higher than the Gulf Coast levels. Another extremely significant additional cost of operation in Puerto Rico was the cost of shipment between Puerto Rico and the mainland in U.S. flag vessels as required by the Jones Act. In 1976, the differential between U.S. and foreign flag vessels was determined to be \$0.46 per barrel. (The Jones Act was amended allowing shipment in foreign flag vessels).

Thus, the Pace report found that the total current annual extra power, industrial fuel and shipping costs of Puerto Rican refining and petrochemical firms vis-avis their

mainland competitors was \$162 million. Furthermore, the Pace report determined that the cost of imported naphtha used by Puerto Rican firms as petrochemical feedstock was \$5.12 per barrel higher than the imputed cost of domestic naphtha, even after the receipt of entitlements. The underequalization of naphtha feedstock costs would amount to \$200 million annually.

At hearings convened in San Juan on March 19-20, 1979 by the DOE's Office of Hearing and Appeals, the Pace Company representative testified that the cost disparities affecting the Puerto Rican refining and petrochemical industries had increased dramatically. The spot market cost of shipping petroleum products from Puerto Rico to the mainland in U.S. flag vessels increased from 2.2¢ per gallon to 6.8¢ per gallon between January and March 1979. The industrial fuel cost disadvantage of Puerto Rican firms had increased from \$88 million to \$96 million between January and March of 1979. The differential continued to increase due to high foreign oil costs relative to price-controlled natural gas and other mainland fuel costs. Electricity costs also increased disproportionately in Puerto Rico due to foreign oil price increases. Finally, the Pace representative stated that Puerto Rican petrochemical firms would be subject to a \$550,000,000 naphtha feedstock cost disadvantage annually on the basis of March 1979 naphtha prices, for a total annual cost disadvantage of approximately \$750,000,000 Puerto Rico's refining and petrochemical industries.

III. CURRENT SITUATION

The refining and petrochemical industries in Puerto Rico were seriously undermined by the close of CORCO's operations and the shutdown of downstream petrochemical firms.

CORCO, and the downstream plants it supplied, constituted one of the largest petrochemical complexes in the world. Furthermore, Puerto Rico experienced an increase in the unemployment rate, a substantial loss in net income, loss of vital supplies of fuel and petrochemical feedstocks, and other losses. The Government of Puerto Rico and the Federal Government have taken a very passive role in looking for alternatives and/or new parties interested in operating the CORCO facilities and redeveloping this industry.

Mr. Lewis Smith stated that unless competitive, secure supplies of crude oil can be obtained and additional naphtha capacity is installed, Puerto Rico's physical plant for the production of fuels and petrochemicals will be of little value to Puerto Rico. He added that if we do not solve this problem, someone may buy our physical plant and, like our sugar mills, take them somewhere else. This has already happened with PPG's PVC plant and Puerto Rico Olefins.

A. The Rise and Fall of CORCO

The adverse competitive position of the industry in Puerto Rico was highlighted by the filing of a petition by

CORCO instituting Chapter XI bankruptcy proceedings on March 2, 1978. CORCO had prospered prior to 1973. The firm expanded its refinery repeatedly and constructed one of the world's largest aromatics plants. CORCO also invested in numerous wholly-owned and joint venture downstream facilities which utilize as feedstocks the more basic petrochemicals produced by the aromatics plant or other facilities on the Island.

CORCO's financial difficulties since 1973 were in large part attributable to the failure of Federal regulatory programs to equalize the firm's costs (especially for feedstocks) with the costs of its competitors. In CORCO's ongoing reorganization, the firm was pursuing many courses of action which were designed to restore the firm's profitability. Long-term Federal action to offset the higher cost of operation in Puerto Rico was undoubtedly required, however, in order to effectuate CORCO's complete rehabilitation as a viable economic entity. Thus, CORCO closed down operations in 1981.

In addition to CORCO's financial difficulties, in November 1978, PPG Industries, Inc. (PPG) terminated operations at the Puerto Rico Olefins Company (PRO) facility and shortly thereafter at its own chemical complex, resulting in the layoff of the 1,300 workers directly employed and 1,300 workers indirectly employed, and the loss of \$100 million per year to the economy of Puerto Rico. Some downstream facilities which were dependent upon PPG/PRO for their feedstock

requirements suspended operations as a result of the PPG/PRO shutdown, most notably Oxochem Enterprise, a joint venture between W.R. Grace & Company and CORCO.

The financial difficulties of the PPG/PRO complex were largely attributable to the firm's feedstock cost disadvantage, as compared with mainland producers, high power costs, and insufficient demand on the Island to enable the firm to operate at an efficient level of capacity. The PPG/PRO complex could have been operated profitably only if the feedstock costs of that complex had been equalized and economic incentives provided for the construction in Puerto Rico of a downstream facility which used as feedstock the petrochemicals (primarily ethylene) produced by PPG/PRO.

1. Dependence of Puerto Rico on Foreign Oil and Naphtha

Puerto Rico depends upon foreign oil for 95% of its energy requirements. Because alternate energy sources cannot supply more than a small percentage of Puerto Rico's near-term energy requirements, Puerto Rico will remain almost totally dependent upon imported petroleum for industrial, transportation, and agricultural fuel, the generation of electricity and as raw material for further industrial development. Perhaps by the year 2000 our dependence upon oil will be reduced, but this will be a function of a strong and vigorous energy development plan by the Government.

Moreover, Puerto Rico will continue to require foreign oil, but at smaller volumes (55% less) than at the peak of the petrochemical industrial development.

Despite the fact that Puerto Rico is without a comprehensive mass transit system, and therefore depends almost totally upon the automobile for transportation, gasoline consumption will increase but at a lower rate than previous years.

Naphtha was the basic feedstock to the petrochemical industry on the Island. Two basic types were:

- Paraffinic Naphtha - Generally considered a lower quality naphtha used as feedstock in the production of ethylene by Union Carbide and Puerto Rico Olefins. Paraffinic naphthas were imported but also both Union Carbide and Puerto Rico Olefins were supplied certain amounts locally (i.e., "raffinate", a paraffinic naphtha produced as a by-product of aromatics manufacture).
- Aromatic Naphtha - a premium quality naphtha used in the production of benzene, toluene, and xylenes. CORCO used to produce a certain amount for its gasoline blending pool and for CPI.

The problem of addressing Puerto Rico's competitive position on naphtha relative to the mainland is difficult due to the fact that naphtha was not a traded commodity on the mainland and there were no "posted" prices. Almost all naphtha used for petrochemicals on the mainland was internally derived

from crude oil. Conversely, Puerto Rican consumers purchased the bulk of their naphtha from foreign sources. As a result, they paid another refiner's processing costs, shipping costs and profit. An understanding, however, of some of the pressures and relationships is important.

- Naphthas containing high amounts of aromatics/ aromatic precursors make excellent high octane motor gasoline blendstocks. Thus, when gasoline demand is strong and prices are high, aromatic naphtha value is high. When naphtha value rises, this causes a rise in the price of benzene, toluene and xylenes.
- Whereas naphtha was not traded on the mainland, the Caribbean was an active trading market for aromatic naphtha. Similar price pressures resulted since Caribbean refiners as well as foreign competitors (Europe/Japan), desire this high octane component in gasoline. Puerto Rican petrochemical producers purchasing in the Caribbean responded to the competitive pressures and "bid" for feedstock.
- During such times, the profit which the naphtha seller expects may be quite high. The benzene producer, i.e., Phillips and CORCO had to pay the high price. The entitlements program compensated them for the difference in this naphtha price and

a mainland producer's value. However, the value of naptha entitlement was limited to the value of a crude entitlement.

2. Power Costs and Service

The supply and cost of electricity are critical elements in the operation of a refinery or petrochemical facility. It is especially important in a power intensive operation such as caustic/chlorine production or where a large number of electric motors are involved.

Power in Puerto Rico continues to be a subject of major concern, both for users and the government. It is also very controversial. In brief, power was more expensive and less reliable in Puerto Rico than on the Gulf Coast, where the Island's refining and petrochemical competition was located.

3. Logistical Problems

Puerto Rico's logistical problems stem from the very obvious fact that it is a small island without significant natural resources and is over 1000 miles from the United States mainland. The island depends upon imports for essentially all of its basic energy, and very high percentages of its food and manufactured goods. Markets for Puerto Rico's products are heavily oriented towards exports, largely because of small local population.

The refining and petrochemical industries were especially affected by logistics in that all raw materials were imported, and most petrochemicals and a substantial portion of refined products were shipped to the mainland. The volume and weight of these materials was very high and the unit value low in comparison with products of other island industries such as pharmaceuticals and electronic components. Therefore, the cost of freight was of much more concern.

The overriding item of concern to refining and petrochemical companies in Puerto Rico, insofar as shipping is concerned, was the Jones Act, which required that shipments between United States ports be made in American flag ships. This was not a significant problem in feedstock supply, since nearly all crude oil and naphtha were imported and moved in foreign flag ships. However, since virtually all product shipments were to the mainland, the Jones Act had a very definite impact. The Jones Act was finally amended to the benefit of Puerto Rico in 1982.

Puerto Rico imported crude, naphtha and salt. Transportation costs for each of these materials differed from those on the mainland and affected the refining and petrochemical industries in Puerto Rico significantly.

4. Labor

Labor costs have risen sharply in Puerto Rico since industrialization began in the 1950's. Average hourly earnings in manufacturing Puerto Rico were 29% of the United

States average in 1950; and are now approaching 60% of the United States average. In the refining and petrochemical industries, the difference was much less.

The cost of labor was not an area of major concern to the refining and petrochemical companies in Puerto Rico because these businesses were capital rather than labor intensive. A review of the manufacturing costs of the principal petrochemicals produced in Puerto Rico showed that labor costs range from 2 - 7% of the total, with most being about 4 - 5%. Thus, even if labor costs changed substantially in either direction, the impact would have been relatively minor. Two industry officials in Puerto Rico commented independently that they could live with higher labor costs, but elimination or sharp reduction of entitlements would put them out of business.

5. Markets for Products

During 1982, the market situation and outlook for refined products and petrochemicals was markedly different from the climate which prevailed prior to 1973. Basically, higher raw material and energy costs, coupled with a slowdown in overall economic growth resulted in significantly lower demands than previously anticipated for many fuels and chemical products.

Insofar as Puerto Rico, the impact was more evident on petrochemicals because they compete in mainland markets more than refined products. Also, as noted previously, petrochemical capacity in Puerto Rico (especially aromatics) was a very significant part of the United States total, while that for refined products was not.

The competitive advantage of United States petrochemicals in international markets declined because the United States no longer had access to low cost supplies and the demand for petrochemicals in Europe - traditionally a major market for United States exports - had over-capacity in most basic products and derivatives.

IV. FUTURE CONSIDERATIONS

Besides ensuring the ready availability of petroleum for Puerto Rico, we need to find more alternatives to crude oil. The government should initiate a great variety of energy-related development as soon as possible. The time factor is of essence, since it takes three to ten years for the commercial implementation of an alternative source of energy.

In addition, the Caribbean Basin Initiative (CBI) represents a breakthrough for Puerto Rico to adopt and act upon specific plans for the redirection of the Island's economy. The Caribbean Basin provides an opportunity for a new focus for government action as a catalyst for new policies and programs. Thus, an excellent opportunity for energy-related projects with our Caribbean neighbors.

A. Biomass Feedstock to be Produced Locally

Puerto Rico should enhance the search for energy alternative to break the dependence on imported oil. That is, 95% of the Island's energy requirements are provided by crude oil and its derivatives. The remaining 5% is supplied by coal, cane bagasse, direct solar energy, and hydropower.

Biomass cropping might provide 10% or more of the Island's electricity by the year 2000*. In the short run, this renewable energy source is very promising and we should expect major results in a five to ten year period. The government is moving to develop this alternative for Puerto Rico's energy future. In April 1986, preparation started for Puerto Rico's first Biomass Project, which will use the existing Aguirre Cane Mill to produce energy, sugar, and enriched molasses from cane, grasses, and perhaps municipal solid waste (MSW) as well. Several other biomass and MSW-to-energy projects are in the pre-feasibility stage. The technological problems are fairly straight forward and the economics are encouraging.

B. Caribbean Basin Initiative

In 1982, a legislative bill entitled "The Caribbean Basin Economic Recovery Act" was introduced in the United States Congress. By 1983, it had been passed by the Senate and the House and, on August 5, 1983, it was signed into

*National Academy of Science, "Energy in Puerto Rico's Future, 1980.

law by President Reagan. Its purpose: to stimulate economic growth and present new opportunities for development while promoting political and social stability in the countries of the Caribbean.

The centerpiece of the program is the provision for unilateral, duty-free, preferential access to the United States market for most products produced by eligible Caribbean Basin countries for a period of twelve years.

An amendment to the CBI passed on October 1985 permits Puerto Rico to take part in the provisions for products entering the U.S. duty-free from Caribbean Basin countries. It is intended to encourage U.S. companies to establish complementary projects, twin-plants, joint production and sub-contracting with Puerto Rico and its neighboring countries in the region.

Under the complementary project concept, U.S. companies can establish an operation in Puerto Rico with U.S. tax benefits under Section 936 of the U.S. Internal Revenue Code. Cost-effective sub-assembly is performed in a twin-plant facility in participating CBI countries; finishing and quality control work are performed in the company's Puerto Rican plant. This thereby spreads the investment and strengthens the entire region economically and politically while reducing production costs for the participating manufacturer.

It provides not only for manufacturers in Puerto Rico to share in the production of goods from CBI recipient countries but also an opportunity for these manufacturers to share their expertise with their Caribbean neighbors, most of whom are in the early stages of industrial development. It will also maintain and strengthen the economic advances Puerto Rico has achieved during the past 40 years.

Puerto Rico has pledged approximately \$700 million in 936 corporate funds deposited with its Government Development Bank as an inexpensive source of funding for complementary projects. These funds are legally restricted for use on the Island.

The essential building blocks are in place: Sophisticated infrastructure in communications, transportation, education, industrial facilities and democratic institutions.

The main provision eliminates duties on all products, with certain exclusion, entering the United States from any of the twenty-one designated beneficiary Caribbean countries. This gives exports from the region significant cost advantages through tariff elimination compared with exports from non-CBI countries. Duty-free treatment will remain in effect until September 30, 1995.

The beneficiary countries are:

Antigua and Barbuda, Bahamas, Barbados, Belize, British Virgin Islands, Costa Rica, Dominica, Dominican Republic, El Salvador, Grenada, Guatemala, Haiti, Honduras,

Jamaica, Montserrat, Netherland Antilles, Panama, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago.

Public Policy and the CBI

Puerto Rico's regionwide development strategy should include the following:

- a) Active participation from the public and private sectors.
- b) Taking part in any movement that encourages increased manufacturing, regional and international trade, and any other means of economic growth (i.e. energy development) that promote mutual benefits for Puerto Rico and its partners.
- c) Creating mechanisms that foster the direct involvement of the participating countries in planning and implementing the CBI.
- d) Complementary projects, not limited to manufacturing, between private-sector companies and the Government of Puerto Rico, and their counterparts in CBI countries.

The CBI program offers an excellent opportunity to establish energy projects of mutual interest to the region. This could be done thru the Center for Technological and Scientific Research and/or the Center for Energy and Environment Research, as a Caribbean institution.

C) Puerto Rico Finance Position

1) Government Development Bank

The Government Development Bank for Puerto Rico (GDB) has launched an important CBI loan program to help promote establishment or expansion of complementary plants in Puerto Rico and CBI designated countries.

Very favorable interest rates and other terms will offer a major incentive for complementary plant development by Puerto Rican based firms expanding into the Caribbean and for Caribbean firms establishing operations in Puerto Rico.

Funding will come in part from the large and growing investment pool of Section 936 funds accumulated in Puerto Rico and channeled to the Government Development Bank. These are tax-free earnings of U.S. corporations operating in Puerto Rico under U.S. Internal Revenue Code Section 936.

Projects will also be financed and cofinanced to the maximum extent feasible by the commercial banks in Puerto Rico.

Under the CBI loan program, the Bank will assist in financing existing or new operations in Puerto Rico. The firms in turn will invest their own resources in Caribbean Basin complementary operations. Loans will be disbursed to the Puerto Rican operations for purposes approved by this Bank.

Financing is available also for complementary operations in Puerto Rico, but where main offices are located in any designated CBI country. The loans would be structured

specifically for the Puerto Rican project segments. GDB may require guarantees by parent firms abroad.

Contacts have been initiated concerning coordinated project lending by Central American and Caribbean regional financial institutions.

The Bank, while giving certain preference to manufacturing, will also consider financing for commercial, service and other activities deemed essential to regional development.

GDB may consider loan applications for the following:

1. Purchase, construction, expansion and/or improvement of industrial, commercial and service facilities.
2. Purchase of machinery and equipment.
3. Medium and long-term working capital when not available elsewhere.
4. Other purposes according to the merits and importance of each case.

2) Office of Energy

Furthermore, the Puerto Rico Energy Office has an allocation of over \$5 million to initiate energy projects that will contribute to develop specific alternatives to imported petroleum. Already under study is the Biomass Project, the addition of coal-burning capability to the Aguirre Electric Generating Station, and several other biomass and solar projects.

D) Venezuela, Puerto Rico Petrochemical Conversations

Government officials have been in conversations with Venezuelan authorities to determine programs of mutual interest in the petroleum-petrochemical industry. More specifically, the officials considered the possibility of re-establishing the CORCO facilities on a joint venture. The major problem encountered has been the cost of operations (millions of dollars) and at present, is a "no go" situation. In addition, PREPA officials are exploring the possibility of buying Venezuelan oil to supply some of the five generating plants-approximately 20 million barrels or 30% of PREPA's consumption. But, it doesn't look very promising due to the quality of the oil and the price.

During the 1970's, Venezuela was the major supplier of crude oil to Puerto Rico, but the situation began to change in 1979, and by 1983-1984 our imports from Venezuela were stopped completely. This was due to various factors, among others, the quality of the product "Venezuelan crude-heavy sulfur oil" vis a vis "light crude oil" from other countries. The Venezuelan oil was not as "pure", and thus not as attractive, since service could be impaired at the generating plants. Also, price considerations and the shut-down of CORCO were factors that caused our shift on crude oil imports to other countries.

On the other hand, Venezuela continues to be Puerto Rico's main supplier of naphtha, with imports of 7.5 million barrels during fiscal year 1984-1985, which represents more than 50 percent of total naphtha imports of 14.5 million barrels.

V. CONCLUSION

The petroleum-petrochemical industry in Puerto Rico was directly affected as a consequence of the increase in the price of crude oil that began with the oil embargo in 1973. Today, what is left of our petrochemical industry, is disappearing very rapidly. This was due to happen with or without the Federal programs (i.e. MOIP, Entitlements, etc.). It has been stated that unless competitive, secure supplies of crude oil can be obtained, and additional naphtha capacity is installed, Puerto Rico's physical plant for the production of fuels and petrochemicals will be of little value to Puerto Rico. In particular, the purchase of CORCO's assets would simply perpetuate the vulnerability of this complex due to unfavorable events in the world crude market. Thus, the current status of the industry.

The Caribbean Basin Initiative provides us with the opportunity to serve as a focus and center for energy initiatives in the Caribbean, including petroleum refining, petrochemical production, and renewable energy alternatives development. We could develop areas of mutual cooperation with our Caribbean neighbors on energy related activities. An agreement that would increase employment, income, and energy-related activities would be in the best interests of the regions of the Caribbean.

An environment that would stimulate development and expansion of energy alternatives and perhaps, restore the facilities left by CORCO and others into productive use (economic value) could be to the benefit of Puerto Rico.

Bibliography

- 1) "Competitive Cost Position of the Puerto Rico Petrochemical Industry", prepared by Arthur D. Little, Inc., May 1975.
- 2) The Petroleum Refining, Petrochemical and Allied Products Industries in Puerto Rico, Economic Development Administration, December 1981.
- 3) La Situación Energética de Puerto Rico/Año Fiscal 1983-84, Oficina de Energía de Puerto Rico.
- 4) Puerto Rico and the CBI: An Alliance for Prosperity, Economic Development Administration, November 1985.
- 5) Puerto Rico's Trade Alternatives, Citibank, December 1985.
- 6) "The Office of Energy Looks at Energy", by Lewis Smith, Puerto Rico Business Review. Government Development Bank, May 1986.
- 7) "Refining and Petrochemicals in Puerto Rico", prepared by The PACE Company, January 1979.
- 8) Estadísticas Energéticas Anuales, Oficina de Energía de Puerto Rico, 1984.

