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Final Report

Romania Downstream Petroleum Restructuring Project

Report of the Rationalization and Critical Investment Study and Recommendations for Implementation

Prepared for

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Energy Restructuring and Regulatory Reform in Central and Eastern Europe and the Baltics

In cooperation with
World Bank

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Executive Summary

Romania is well into the transition from a strict socialistic command-and-control system to a capitalistic, free-market economy The government-owned downstream petroleum sector is one legacy of the prior system that must be restructured and privatized to proceed with this transition

To facilitate this restructuring and rationalization process, and provide support to the efforts of the World Bank to fund a loan for the critical investments necessary, the United States Agency for International Development (USAID) is providing assistance to the Government of Romania under the *Energy Restructuring and Regulatory Reform in Central and Eastern Europe and the Baltics* program Bechtel International, Inc is the prime contractor and implementor of this USAID assistance program In the performance of this Romania Downstream Petroleum Restructuring Project task Bechtel was assisted by U S subcontractors Arthur Andersen of Houston, Texas and Intratech of McLean, Virginia. In Romania, the Team was assisted by subcontractors Energy Consulting S R L and Infochem Members of the USAID and World Bank staffs in Bucharest and Washington DC provided valuable input in the execution of this study

Romania's downstream petroleum sector has many harmful distortions caused by the vestiges of central planning and continuing government intervention Romanian consumers are paying excessive prices for refined products, Romanian oil producers are receiving low prices for their oil, and the Romanian government is being deprived of an important source of tax revenues All of these distortions perpetuate an inefficient sector that is burdened by structural overcapacity and excessive employment

To cure these problems, fundamental and radical change are necessary The government's involvement in the sector needs to be relaxed, prices must be permitted to respond to market conditions, and capacity and employment must be rationalized Only then can the sector be restored to profitability and subsidies eliminated Following that the sector will be able to generate investment capital and use it productively

Shown below in Figure ES-1 is an overview of the downstream petroleum sector including the major activities performed and the enterprises that perform them These will be discussed in the sections that follow

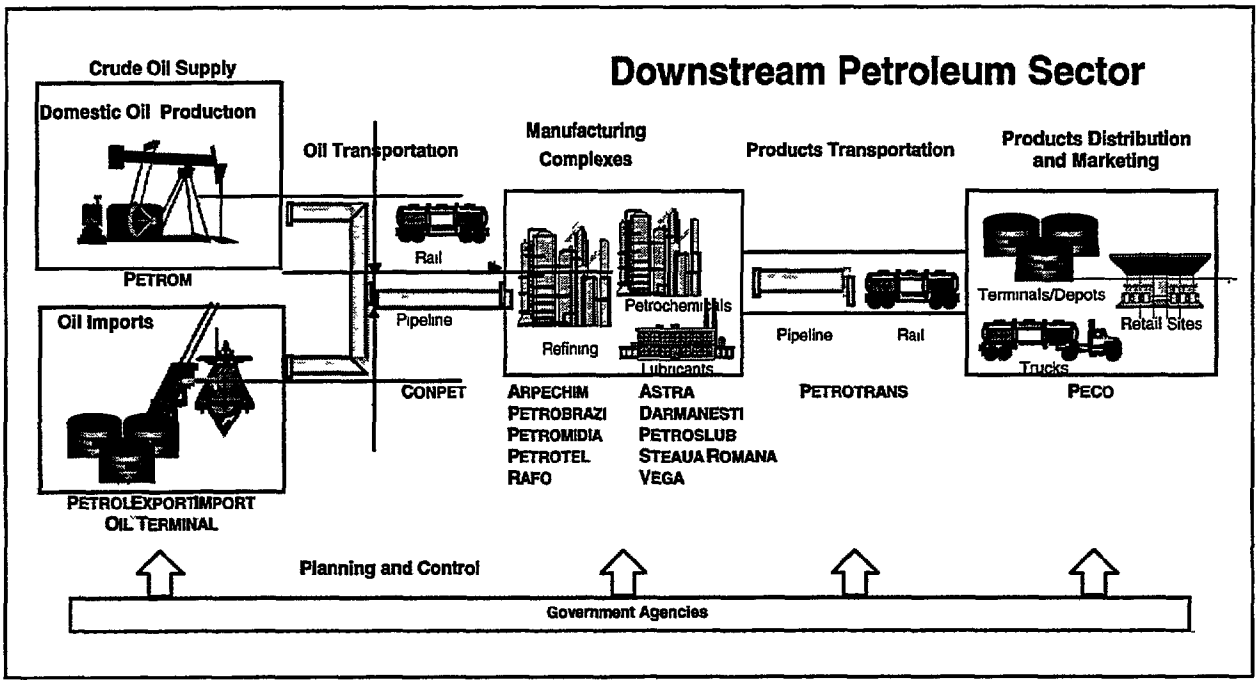

Figure ES-1

ES 1 1 DEMAND AND PRICES

Demand for refined products, petrochemicals, and lubricants forms the basis of our analysis of required capacity over the next 10 years Required capacity, in turn, serves as the basis for assessing how much of the existing capacity will be needed and how much is redundant and should be closed Where existing capacity is higher than demand, and such conditions are likely to continue, excess capacity must be shut down so that the sector can be made economically viable and efficient

In all of our analyses, we have deliberately tilted the demand forecasts toward the higher end of the range of expected outcomes In this way, we have sought to ensure that excess capacity in the downstream sector could be viewed in light of favorable conditions that might reasonably be expected to occur This minimizes the risk that any shutdown recommendations will be premature We believe that the shutdowns recommended herein are premised on reasonable expectations about future demand and, therefore, capacity requirements

Overall, the Romanian economy has been projected to continue to grow, at a pace somewhat above current levels We have projected Gross Domestic Product (GDP) to grow at a compound rate of 4 0% for the next 10 years

The petroleum demand projections, shown in Figure ES-2, assume modest growth in real oil prices, averaging $1 50 per metric ton annually over the period, excluding inflation Based on annual economic growth of 4 0%, refined products demand is projected to grow at a rate of 3 0%

per year through 2000 and 2 7% thereafter through 2005, rising from 14 8 million metric tons (MMT) in 1995 to 19 7 MMT by 2005

Within categories of refined products, growth is expected to be higher for lighter products with motor gasolines growing rapidly at 4 5% per year and diesel growing robustly at 4 0% per year Growth is expected to be lower for heavier products, such as fuel oil (which grows at just 1 0%), that are used primarily to fuel industrial and power plants Because of environmental issues, the sulfur content in diesel and fuel oil is expected to decline rapidly through displacement by low-sulfur products Overall, clean fuels are projected to rise from 43% of the overall fuels mix in 1995 to 48% by 2005

Petrochemical demand is also projected to grow rapidly, rising 4 6% annually over the 10-year period, including exports In the domestic market, petrochemical demand is expected to soar, rising 6 0% annually over the 10-year period, reflecting expectations that Romanian consumption will move closer to that of the European Community in items such as plastic and rubber products, synthetic yarns and fibers, etc The export market, consisting of regional economies that are growing less rapidly, is expected to grow at 3 3% annually over the 10-year period In Romania, the major petrochemical products including polyethylene, polypropylene and acrylonitrile, are projected to grow 4 4%, 4 1% and 3 6%, respectively, per annum over the 10-year period

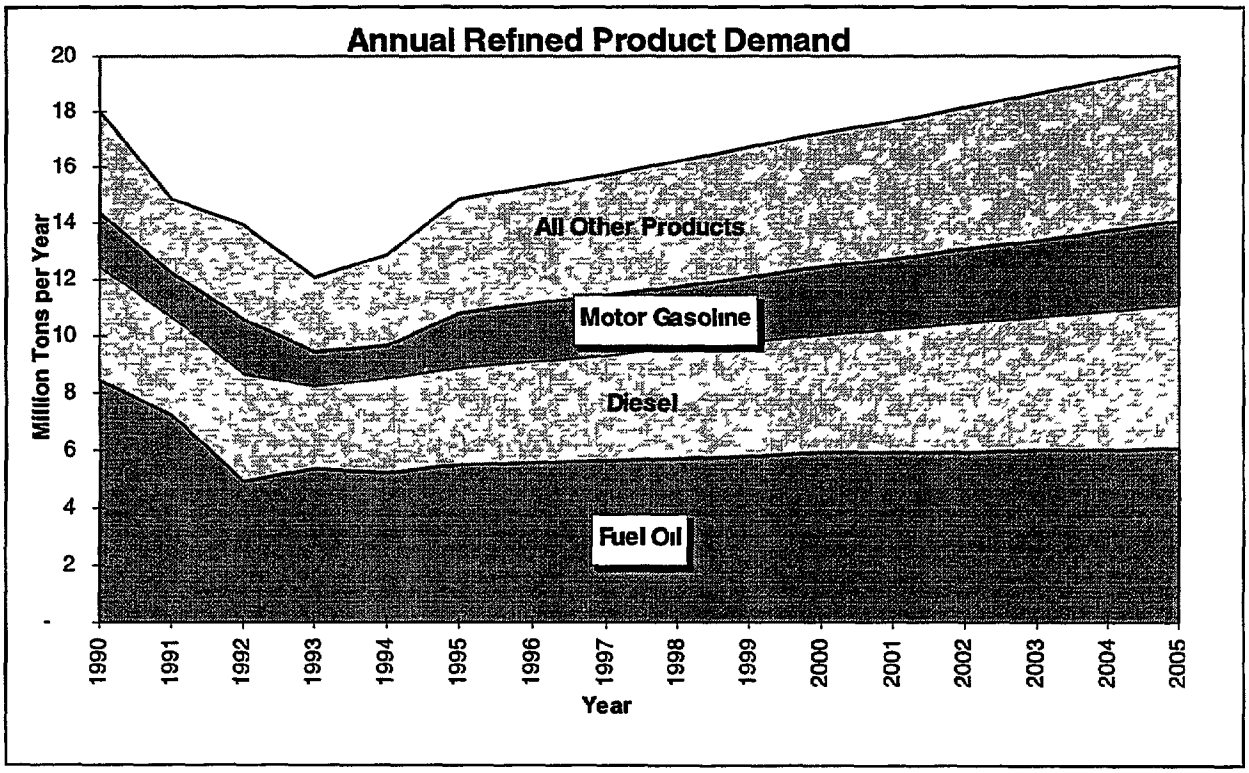

Figure ES-2

Refined products prices are projected to grow at modest real rates over the 10-year period, averaging 1 5% for motor gasoline, 1 8% for diesel and 0 7% for fuel oil Petrochemical prices, which vary widely on a cyclical basis, were not projected for modeling purposes, but instead were assumed to remain constant at 1995 levels over the entire 10-year period As shown in subsequent sections, those petrochemical prices are relatively higher than can be expected in most future years, however, the use of abnormal prices has no important impact on our conclusions about closure of one plant versus another

It is important to note that in all of our analysis of the manufacturing complexes, the prices for crude oil, refined products and petrochemicals are based upon market pricing rather than the current regulated pricing By applying market prices to domestic purchases and sales, as well as imports and exports, it is possible to obtain a clear view of the relative economic attractiveness of manufacturing products for domestic use or export versus importing Market prices are better tools than regulated prices in evaluating economic viability and were applied in valuing feedstock supply, product sales, and exports While we used projected future prices in our analysis, historically price forecasts have not been reliable because of actions taken by the Organization of Petroleum Exporting Countries (OPEC) We do not need to predict future prices accurately to assess the performance of enterprises whose results are all priced using the same assumptions The absolute level of market prices will change with market conditions, however, such changes have very limited impact on the conclusions about retaining or shutting down one plant versus another

In all cases, international market-based, distance-driven transportation costs were included in our determinations instead of the regulated tariffs applied in Romania. Such cost-based transportation expenses were applied based upon actual distances to and from the refineries and import/export points to ensure that these important factors were considered in our conclusions

ES 1 2 MANUFACTURING

The manufacturing sub-sector includes refineries, petrochemical plants and lubricants operations, which are integrated into large manufacturing complexes The most important consideration is structural overcapacity in refining Lesser issues involve technological obsolescence at units within the petrochemical plants and at all of the lubricants units

ES 1 2 1 Economic Benefits of Our Recommendations

Under Romania's controlled prices, the downstream sector appears to be profitable but, in fact, manufacturing alone is losing almost $1 0 million per day, a total of $305 million per year when market prices are considered Market-priced economic results for the sector are difficult to obtain as all reported results are heavily distorted by cross-subsidies into and out of the sector and between members within the sector Table ES-1 shows our construction of the economic loss for manufacturing based on market prices for this important part of the sector Because all data were not available on a consistent basis, the results had to be estimated using a combination

of 1994 and 1995 data obtained from a variety of sources The net result is not exact, but the order of magnitude of the loss is correct for illustrative purposes

Table ES-1
Current Economic Loss from Manufacturing
10 Refining Complexes – 1994/1995 Data

	$ Millions
Reported "Operating Profits" from Manufacturing	**139**
Eliminate Subsidies Reflected in the Operating Profits above	
Domestic Crude Oil Purchased *Below* Market (1)	(269)
Refined Products Sold *Above* Market (2)	(230)
Petrochemicals Sold *Below* Market to Others (3)	55
Total Net Subsidies	**(444)**
Real Annual Economic Loss from Manufacturing	**(305)**

(1) In late 1995 the market price of imported crude oil delivered in Romania had a cost of $134 per ton as compared with the $92 per ton paid to Petrom This represents a $42 per-ton subsidy from Petrom to the refiners on an annual volume of 6 5 million tons of domestic crude oil, a total of $269 million per year

(2) Refinery gate prices of $162 per ton charged by the refiners in 1995 were approximately 12% higher on average than international prices On the 11 8 million tons of refined product sold in the domestic market this represents a subsidy from consumers to the refiners of a total of $230 million per year

(3) Petrochemicals products used in the domestic market in 1995 were sold at prices which, on average were 36% lower than the $790 per ton international price On the 193 000 tons sold, the petrochemical sub-sector subsidized other industries at a total cost of $55 million, net

The $305 million annual economic loss from manufacturing results from two major interrelated factors

- The manufacturing sub-sector is plagued with huge overcapacity In refining 10 plants operate when six would meet domestic demand This leads to massive dis-economies, for example
  (a) Excess employment is very high The 10 plants employ 37,700 people when only 12,900 employees and contract workers could meet the needs By continuing to employ 24,800 excess people in the workforce at an annual average cost of wages and benefits totaling $3,076 per person, a cost of $76 million per year is incurred, contributing to the sector's real economic loss
  (b) To keep all 10 plants operating, the refineries process too much crude oil, a total of 18 MMT of crude oil when 10 MMT would produce better results The extra crude oil is cycled into the refineries from imports and virtually all products are then exported, an activity which conclusively produces losses, which we estimate

at $20 per ton on the extra 8 MMT This represents an avoidable loss of $160 million per year

(c) Maintenance, utilities, insurance, and taxes are incurred on the four unneeded plant complexes, an avoidable cost of $85 million per year

- The existing plants are operated very inefficently

(d) The operating practices used are based upon unchanging (set-it-and-forget-it) operating paradigms which sub-optimize product yields and contribute to excessive destruction of products through fuel use and loss in manufacturing We estimate that the costs in substandard yields (product giveaways) and excessive hydrocarbon losses (or unaccounted-for-losses) total at least $130 million per year This significantly contributes to the sector's real economic loss

(e) To pay for crude oil, the refineries engage in costly barter arrangements which destroy value through transportation and uneconomic pricing The costs of these practices are included in item (b) above The foreign currency costs of barter arrangements are discussed in subsequent sections

The substantiation of the estimates shown above is demonstrated in the highly sophisticated economic models presented in the subsequent sections of this report The possible improvements are detailed in Table ES-2

Table ES-2
Potential Annual Profits After Capacity Reductions
With Rationalization and Improvements in Operating Practices Using Market Prices

		$ Millions
Calculated Economic Loss of 10 Manufacturing Complexes		(305)
Improvements Estimated in (a) through (e) above		
Eliminate unnecessary labor	76	
Eliminate excess crude runs that produce losses	160	
Maintenance, utilities, insurance, etc , on four unneeded plants	85	
Eliminate excess fuel use and product losses in manufacturing	130	
Total Identified Improvements (a) through (e)		451
Other		(4)
Total of All Improvements		**447**
Expected Operating Profit with Six Manufacturing Complexes		**142**

Based upon a net loss of $305 million per year, the Net Present Value (NPV) of the manufacturing complexes **negative** $2 7 billion, using a 10% discount rate and 20 years of net cash flows The assets used in manufacturing represent a major investment for the nation Their NPV is unknown, but the current replacement cost would likely exceed $10 billion Certainly, these facilities would not be rebuilt at such a high capacity and clearly only using newer technology However, this figure gives an indication of the value of assets that are being deployed with no economic returns and, in fact with extraordinary destruction of value

In addition to the gains in profitability of this downstream sector, Table ES-1 shows that using market-based prices the upstream sector would receive $269 million more per year to use in exploring, developing and producing crude oil to reduce the nation's dependency on imports The economic value of reduced imports has an NPV of $4 8 billion over the next 20 years Table ES-1 also shows that either (1) consumers would enjoy lower prices of $175 million (net) per year or (2) alternatively, the government could impose excise taxes to fund other vital national interests such as restoration and expansion of the nation's highways, roads and mass transit systems

Once a rationalization plan is implemented and true economic operating profits rise from a loss of $305 million per year to a profit of $142 million per year, the six remaining manufacturing complexes will have a positive NPV of $1 2 billion over 20 years, fully $3 9 billion more value than the sector has under current policies and practices

ES 1 2 2 Foreign Currency Implications

The recommended rationalization offers important opportunities to dramatically reduce Romania's foreign currency requirements for importing crude oil and refined products Over time, the reductions in production can reduce these requirements by more than half, saving on a NPV basis more than $2 4 billion over 20 years The detailed calculations are very lengthy and are not reproduced here A simplified representation of the most important impacts is presented in Section 2 and is summarized in Table ES-3 below

Table ES-3
Foreign Currency Costs
$ Millions, Using Market Prices

	Annual Cost (1)			
	1995	2000	2005	NPV
Current Costs Under Existing Operating Practices (2)	985	1,273	1,635	10,825
Reduction Under the Proposed Rationalization (3)	(16)	(378)	(595)	(2,439)
Costs Under Our Rationalization Recommendations (3)	969	895	1,040	8,386

(1) All amounts exclude capital investments in the manufacturing complexes and any costs other than hydrocarbons used in the sector Oil prices based on 1995 levels, rising $1 50 per annum thereafter Net exports of petrochemicals are also excluded but would be the same under both scenarios

(2) Represents 10 refineries operating and initial processing of 18 MMT of crude oil, rising with demand

(3) Primarily represents new domestic oil supplies discovered by releasing the $269 million per annum subsidy by Petrom to the refining sub-sector Excludes the four closed refineries and assumes no barter processing is performed

There are exceptional benefits to the Government of Romania the petroleum sector and to customers in implementing the recommendations reflected in this report

ES 1 2 3 Refining

In the refining sub-sector, the existing capacity is 33 million metric tonnes (MMT), which is almost twice the amount required to economically meet demand over the next 10 years, even after assuming robust growth in consumer demand Despite the excess capacity, all 10 of the refineries are operating, leading to wasted resources and destruction of badly needed capital With 10 refineries operating, our analysis above shows that under market-based pricing, Romania's refining industry is losing enormous amounts of money, on the order of $300 million per year These losses are hidden through a variety of large subsidies from producers and from consumers, but are nonetheless very real As shown above, we estimate the total subsidies to be $444 million annually, of which over half is provided by below-market prices to Petrom The rest of the subsidy is provided by above-market prices charged to consumers These annual subsidies work out to $12,000 per year for each employee in the entire petroleum manufacturing sub-sector, about four times the average wage costs of an employee These massive subsidies are not being used to strengthen the refiners, but are being dissipated through inefficiency and waste, leaving the refiners unable to afford needed investment to improve operations and clean up the environment

Demand growth over the foreseeable future will not be enough to make the operation of 10 refineries profitable Unless refining capacity is rationalized, these problems will continue for more than a decade or longer Romania's demand for refined products, even with rapid growth, can be readily met by reducing operating plants from five to three large refineries and from five to three small refineries After extensive analysis, based on quantitative and qualitative factors,

we have concluded two large and two small refineries should be permanently shut down and decommissioned

In assessing the viability of retaining existing refining capacity, rather than reducing it, we considered the potential economic consequences of using the surplus refining capacity to support the export market If such export trade were possible on an economic basis, the surplus refinery capacity could be utilized in that way The results were conclusive Export trade is just not economic on a sustained basis

The problem with export markets in the Mediterranean is that they serve as a market of "last resort" for incremental balancing of markets In the Mediterranean market many regional refiners dispose of surplus products that they do not sell in their home markets Those sellers have no other viable market alternatives and the buyers of their products obtain low prices because of excess supply No refiner can profit by importing oil and exporting refined products in the Mediterranean Our analysis shows that just the spread between the price of crude oil and the price of refined products is negative in the Mediterranean market and has been so for many years Under these conditions and using market crude prices, the value of all of the refined products made by the Romanian refineries would be 10% lower than the cost of importing the crude oil alone This huge loss would be made even larger by adding in the variable and fixed costs of operating the refineries

We analyzed each Romanian refinery and determined that none of them, including Petromidia, can avoid losses by serving export markets on a sustained basis Occasionally, there are brief opportunities to capitalize on aberrant market conditions and earn a profit on a single shipload of oil or partially refined products in the Black Sea These temporary opportunities will be rare and cannot make Romania's surplus capacity economically viable

Our analysis confirms that suspension or "mothballing" of refineries would not be enough The refineries must be decommissioned through either sale (in whole or in part) or through scrapping of equipment, or some combination of both Suspension would simply be too expensive and the ongoing costs to keep plants suspended would be borne without any assurance that the refineries could be brought back on line We also concluded that any long-term needs for future additions to capacity can be more economically achieved through future expansion of the remaining refineries than through potential reactivation of surplus plants

The existence of any suspended plants would eliminate the interest of potential investors in the remaining viable refineries Potential investors will quickly recognize that a healthy industry can only exist if supply and demand are in balance They will not invest if there is a looming threat that this delicate balance can quickly be disturbed by introducing a suspended plant into the marketplace

Lastly, essential benefits of the capacity rationalization are derived from fixed-cost savings which are only realizable upon plant closure If suspension were employed, staff reductions and other

cost savings would be unlikely to occur at the necessary levels and the significant benefits of downsizing would not be realized These reasons form a compelling case in favor of permanent downsizing of the refining industry through decommissioning of surplus plants

A trimmed-down refining sub-sector will be much more efficient and profitable, despite the inevitable allowance of producer prices rising and consumer prices falling to market levels An alternative to lowering consumer prices is for the government to take this opportunity to impose excise taxes to raise revenues and maintain pressure on energy conservation, using the tax revenues for vital national purposes such as upgrading the nation's transportation infrastructure of highways, roads and mass transit After rationalization, the refiners themselves should be able to generate reasonable profits, giving them the opportunity to generate sufficient capital on their own to enable reinvestment in badly needed improvements in facilities and management systems

In summary, the refinery sector can be characterized by the following key issues

- The refineries currently operate at a significant real economic loss
- Excess capacity of refineries cannot be absorbed by demand growth
- Importing crude oil for production of fuel oil or re-export of product is fundamentally uneconomic
- The excess refinery capacity must be decommissioned

ES 1 2 4 Petrochemicals

Four of the manufacturing complexes have petrochemical facilities Arpechim, Petromidia, Petrotel and Petrobrazi Within Romania, petrochemical products sold in the domestic marketplace are priced at below-market, regulated prices Petrochemical plants are used to subsidize other industrial producers who use such products in manufacturing finished products, some of which are also sold in export markets Petrochemical products which are exported are sold at market prices Using market prices, the petrochemicals operations presently contribute approximately $48 million annually to the sector on a pretax basis

The most important elements of the petrochemicals sub-sector are the major ethylene and propylene derivatives businesses which are basically sound The problems in this sub-sector all involve the secondary assets and redundant capacity Because of obsolete technology, overcapacity in certain types of products, and low levels of operating capacity in others, we have concluded that portions of each of the petrochemical plants are not, and cannot become, economically viable and should be permanently decommissioned In the case of Petrotel, all petrochemical units should be shut down, as these units are not viable with the refinery operating and they clearly cannot be viable after the refinery is closed At Petrobrazi, most of the petrochemical units are not viable While small units producing anhydrides are viable if the refinery is operating, closure of the refinery will render them non-viable because of feedstock supply disruption The specific facilities are detailed below

- At **Arpechim**, the ethyl benzene and EDPM rubber units are non-viable and should be permanently shut down and decommissioned For reasons discussed below, all currently idle facilities, including styrene, polystyrene and ABS units, should be decommissioned
- At **Petrotel**, the styrene, polystyrene and ABS polymers units cannot operate economically because of obsolete technology and should be decommissioned Also at Petrotel, the polypropylene unit is redundant to a similar and better facility at Petromidia and both facilities are operating at far below capacity We recommend permanent shutdown and decommissioning of the polypropylene unit at Petrotel and moving the production to Petromidia which can fulfill all foreseeable demand more economically
- At **Petrobrazi**, the ethoxylates, phenol/acetone, and DMT are not economically viable While the small anhydride units are currently economically viable (in a complex that is non-viable overall), they cannot operate economically should the Petrobrazi refinery be closed

We recommend that all of the units identified above be shut down We also recommend that all petrochemical prices be gradually deregulated and sold at market prices

ES.1 2.5 Lubricants

Lubricant facilities are integrated in five of the state-owned manufacturing complexes All of these lubricant facilities are severely disadvantaged against import competition The technology used is obsolete, the facilities are old and in poor repair, and management and operating practices are not competitive Collectively, this results in products of inferior quality made worse through contamination in handling in the distribution process Product packaging needs to be upgraded to compare with that of imported lubricants

As a result of the foregoing, nearly 100% of the private automotive lubricants market has been lost to foreign competitors These competitors offer high-quality branded products in attractive packaging and support their offerings through effective marketing and distribution Foreign companies have commanded this dominant share, despite significantly higher prices, because Romanian consumers value their real and perceived product quality In our view, the consumer automotive market has been permanently lost by the Romanian lubricants manufacturers and PECO The costs of matching the quality and image of the foreign companies would be enormous and none of the Romanian enterprises have the resources to do so

The remainder of the lubricants business consists of lubes and waxes supplied to industrial customers (including the military) and the commercial automotive market So far, these markets have been retained by the refiners and PECO due to the absence of foreign competition and the fact that the buyers substantially consist of state-owned companies, who buy based on historical relationships and low price rather than quality On balance, two of the lubricants operations

serving this market Astra and Petrotel, are potentially viable in the near term We have concluded that the lubricant facility of Petrotel can operate independent of the refinery The lubricant operations of the others (Arpechim, Vega, and Steaua Romana) cannot become viable and should be permanently closed

Astra and Petrotel lubricant facilities currently operate at a loss They operate at break even profitability without considering any fixed costs charges We have assumed that the costs of operating these remaining facilities can be reduced, that throughput can be increased by consolidating the production of all five facilities into these two, and that operational improvements could be made to improve yields

Long term, however, once the lubricant customers become private-sector companies and once foreign competitors gain access to this market, the Romanian state-owned lubricant operations are expected to become and remain uncompetitive This can only be prevented if the manufacturing staffs acquire new commercial skills and upgrade their operating practices, especially in quality and customer service In the short term, we do not recommend closure of the lubricant operations at Astra and Petrotel unless costs cannot be reduced

ES 1 3 DISTRIBUTION AND MARKETING

The nature of the problems affecting the distribution and marketing sub-sector is different from those affecting other sub-sectors However, the problems have similarly destructive results Along the chain of activities of the state-owned companies in this sub-sector, refined products are sold by the refiners to PetroTrans which transports and resells them to PECO, which then sells them to the ultimate customers

In transportation by the state-owned company, PetroTrans, country-wide tariffs are substantially equalized despite important differences in the costs of serving markets nearest to and most remote from the refineries This results in overcharging the customers easiest to serve and undercharging those that are most difficult to serve, perpetuating inefficiency in the whole economy

As mentioned earlier, refinery gate prices are higher than market prices In the delivery process, transportation costs, distribution costs and retailer costs are added, plus a margin for all of them, to derive the final prices to the customers Ultimate prices to customers are well above market levels, yet none of the state-owned companies receives a fair margin in the distribution and marketing process

The level of sharing among members of the delivery chain is significantly different from that in market economies In gasoline, for example, our analysis demonstrates that PetroTrans receives $8 75 per ton for its services, over twice as much as the $4 13 per ton received by transporters in the United States (USA), and that PECO receives $26 50 per ton, over two-thirds less than the $82 30 distributors and marketers receive in the USA We did not analyze other products but would expect to find similar distortions there as well Based on this analysis, the international

companies have not entered into the bulk distribution business in Romania In addition, PECO is experiencing great difficulties in its business given the unrealistically narrow margin that PECO receives

PECO is compelled to buy from PetroTrans, yet its private-sector competitors are not PECO is severely disadvantaged in competing, especially in its best markets, and these disadvantages have their origins in two practices First, independent retailers pay their bills promptly while PetroTrans and PECO do not Refiners are willing to discount their prices to independents because of timely payment Second, independents can use private trucks to pick up products at the refineries and thereby bypass the high-cost zonal tariffs charged by PetroTrans PECO cannot do either of these and therefore has a higher cost of serving customers Final customer prices are regulated based upon the cost of the state-owned enterprises, with PECO effectively charging the maximum Its independent competitors, however, enjoy lower costs, providing them better profit margins which they can use to offer better facilities, longer operating hours and better service to customers and still earn acceptable profits As a result, the independents have captured over half of PECO's retail market in just a few years and will continue to erode PECO's share

PECO's losses are mounting, rendering it unable to invest at the same time that its competitors are building modern retail sites and offering consumers more choices PetroTrans has very substantial fixed costs and its transport volumes continue to fall The already high per-ton transport cost charged by PetroTrans continues to escalate, making the problem for both of them worse over time Unless these policies are changed, this cost death spiral will eventually bankrupt both companies

PECO remains the only refined products distributor, controlling all of the 154 bulk terminals and the smaller depots Through this control, it is a monopoly supplier to industrial and agricultural customers These captive industrial and agricultural consumers are being overcharged to support this uneconomic distribution system This system is plagued by inefficient distribution facilities, and modes of transportation and underinvestment, all of which leads to product contamination and environmental degradation

These problems can be cured by releasing PECO from all obligations to use PetroTrans and by causing PetroTrans to become cost-competitive by rationalizing its own cost and price structures using market principles instead of regulated cost-based pricing for all shipments By removing the excessive cost burden of PetroTrans from PECO, PECO will be able to generate badly needed capital to modernize its retail and distribution system The refiners, PetroTrans and PECO should be given the right to refuse to sell to customers who cannot or will not pay on a timely basis Moreover, price regulation must be replaced with a system of market pricing to rationalize the cost and margins along the distribution chain

PECO itself needs to rationalize its business by closing redundant distribution facilities, shutting down low-volume retail sites, and rationalizing its staffing levels and improving its management and operating practices Modernization and upgrading are necessary throughout the distribution

and marketing sub-sector in order to improve customer service, speed up product flow and protect the environment PetroTrans must also rationalize its cost structure and revise its pipeline tariffs based upon distance and service levels with many more zonal demarcations

ES 1 4 GOVERNMENT INTERFERENCE

The downstream sector as a whole is significantly distorted by excessive governmental interference Crude oil supplies to refiners and supplies of refined products to PECO are controlled and allocated Prices of oil supplies, refined products, and transportation are set at artificial levels to subsidize the refiners at the expense of oil producers and consumers State enterprises are compelled to do business with one another even if it renders them uncompetitive against others in the marketplace Each of these problems is discussed below

ES 1 4 1 Supply Control and Allocation

Supply planning is imposed, effected by the refineries, and implemented through PetroTrans and PECO Shortages, logistical delays and other supply diseconomies are routine and costly to the companies and to consumers Central planning also imposes on refiners the crude oil slate chosen on their behalf rather than the one best suited to their refineries

ES 1 4 2 Price Controls and Subsidies

Below market pricing deprives domestic crude producers of the capital they need to explore, develop and produce more crude oil, aggravating the need for imports and draining hard currency At the refineries, price controls subsidize capacity that is not needed and impose burdensome excess costs on consumers Petrochemical manufacturers subsidize other industries through below-market prices In transportation, price-controlled tariffs subsidize those consumers that are most costly to serve and penalizes those easiest to serve The costs of all of these price controls ultimately are imposed on final consumers, at once making prices higher than they need to be, reducing product availability, and pushing out the opportunity for the government to impose reasonable excise taxes to fund vital national investment

ES.1.4 3 Industry Structure and Tariffs

Government interference and the industry structure itself have other harmful effects PetroTrans serves as both a buyer and reseller of refined products, but its only real function is as a transporter This separates the refiners from their true customers and separates the distributors and marketers from their real suppliers This slows down the order placement and fulfillment process and needlessly inflates working capital requirements along the chain The requirement that PECO buy from PetroTrans raises its costs and provides an opportunity for independent retailers Artificial transport tariffs and inflated refinery gate prices are promoting illegal product trading across the

nation's borders Requirements that state-owned companies be served even when they cannot or will not pay are creating a financial blockage of escalating proportions

ES 1 4 4 Currency and Credit Support for Imports

One current and important role for the government is to support the importing of crude oil and refined products through conversion of Lei into hard currency and issuance of letters-of-credit Until Lei become convertible, it is unlikely that international traders will conduct business with the refiners without such support Currently, this support is provided through organizations that do not have responsibility for economic performance of any of the other operations of the sector Ultimately, those that do bear such responsibilities must also assume these import and trading roles, in our view the sooner the better Refiners, for example, can optimize their refinery yields through proper selection of crude oils and through opportunistic processing of other partially refined product streams that come available in the Black Sea and Mediterranean markets Until they are exposed to the trading markets, refiners cannot be positioned to realize the benefits of trading

ES 1.4 5 Non-payment by Customers

Under government policy companies in the downstream sector are compelled to deliver products to some state-owned companies (such as Renel) who do not pay their bills promptly Currently the refiners have enormous receivables they cannot collect and owe Petrom enormous sums they cannot pay The downstream sector cannot operate properly if it is continuously decapitalized Regardless of whether or how past payment problems are resolved, the companies in the sector should be permitted to sell in the future only under commercial terms, with expectations of prompt settlement of accounts with all parties Each enterprise must be given the opportunity to sell only if the customer continues to pay for all future deliveries We recommend that this apply prospectively and not depend upon payment of amounts owing for deliveries preceding the date of adoption of our recommendations

ES 1 4 6 Recommended Actions

The following actions must be taken to eliminate the harmful consequences of government interference

1 Remove all price controls over crude oil and refined products, petrochemicals and lubricants over a relatively brief period coinciding with the refinery closures Until a competitive marketplace develops, tie all prices directly to international import parity levels and update the prices used and the exchange rates used on a monthly basis or more frequently

2 Immediately allow all suppliers to refuse to sell to any party that prospectively becomes delinquent in payment terms Existing arrears in payments should be expeditiously resolved

3 Immediately remove all requirements that PECO purchase or transport only through PetroTrans

4 Require PetroTrans pipelines to be converted to common carrier status at regulated tariffs based upon distance and service levels

5 Establish fair practice regulations to prevent buyer and supplier alliances to fix prices or negotiate on a combined basis

6 Establish import licensing procedures whereby the refiners can directly obtain letter-of-credit support and hard currency exchange rights to enable them to purchase imported crude oil and products, and export products

7 Establish a regulatory agency (or empower NAMR) to establish and enforce quality standards and measurement standards for products sold to consumers (other than industrial customers) and reasonable environmental standards for manufacturing, transporting and storing petroleum and its products

ES 1 5 LABOR

Over 57,000 people are employed in the downstream sector, including 37,700 in the overstaffed manufacturing complexes Our labor analysis covers only the manufacturing complexes

Closure of four of the 10 refineries will reduce staff by 17,000 people At the remaining six sites, another 8,000 employees should cease to be employed through early retirement and termination (or severance) programs, with appropriate retraining and compensation As a long-term efficiency move, we recommend that most remaining maintenance personnel, 2,500 people in total, be moved into separate service companies formed for the purpose of offering maintenance services on a contract basis to the refinery complexes As a percentage of the overall workforce, there were more redundant employees in maintenance than in any other area Maintenance outsourcing companies are one way of preventing a recurrence of this problem in the future

After payment of severance compensation and retraining costs, we estimate that the annual wage and benefit savings will be about $3,000 per terminated employee, a total of $76 million per year after 1998 During the intervening years, the personnel would receive compensation, severance and training benefits roughly equivalent to their current annual compensation and benefits No cost savings are expected before the end of this period However, on a Net Present Value basis, the net benefit will aggregate a value of more than $460 million overall

We did not estimate the necessary reductions in staffing levels for distribution and marketing, but expect them to be of equivalent magnitude for distribution and proportionately lower in retail marketing

There are potential offsets to the inevitable employment dislocations such as the resulting growth in retail and marketing Already, private-sector retailing network has developed, a total of over 600 retail sites are now independently operated We believe that the overall retail sector, which now has 1,100 sites, could rise to at least 2,500 sites and perhaps as many as 5,000 sites, creating a minimum of four jobs per site to as many as 10-15 jobs per site on average Accordingly, employment gains in the retail sector could more than replace the losses in the manufacturing sub-sector The expanded retail sector would also require expanded distribution terminals and depots to support the new sites This will offset some of the inevitable reductions in the existing distribution system, especially as automated terminals are introduced All of these activities, in turn, employ construction crews during the buildup period, maintenance crews over the long term, and ongoing supply and service, creating new jobs in a more vibrant and healthier sector

ES 1 6 ENVIRONMENT

Our environmental assessment covered the refining, petrochemicals and lubricants plants at the 10 manufacturing complexes, but did not cover the transportation, distribution and marketing sub-sector Overall, manufacturing operations have caused, and continue to cause, severe environmental damage due to pollution of air and water

ES 1 6 1 Manufacturing Complexes

The most severe problems result from air emissions, wastewater pollution and solid waste deposits Air emissions include sulfur dioxide, hydrocarbon emissions and other emissions from fired process heaters at the refineries Sulfur recovery units are badly needed Storage tanks need to be modified to reduce losses through evaporation of hydrocarbons Combustion efficiencies of large process heaters need to be improved Wastewater flow rates must be decreased through reductions in cooling-water and steam-condensate losses Wastewater contaminant levels must be reduced through redesigned separators and improved clarifiers Solid waste systems need to be improved through replacement of inorganic wastewater chemicals with organic polyelectrolytes, and through dewatering facilities for biological and oily sludge To clean up landfills, which are improperly constructed to prevent groundwater contamination, oily sludge should be dewatered onsite to reduce volume and the residual sludge needs to be impounded in secure landfills Past groundwater contamination represents a serious problem and will require extensive additional efforts to assess the level of the problem and the form of remediation

In refinery rationalization, handling of the decommissioning and cleanup activities will require (1) that inventories be worked off, (2) that equipment be drained and cleaned and sludges and

wastes be processed, (3) that equipment be removed for sale and scrap and (4) that other cleanup and closure activities, including filling pipelines with concrete or drilling mud, be performed This process will require approximately two years and must be carefully conducted to avoid additional contamination of the environment

The overall cost of environmental improvements, landfill remediation and refinery decommissioning is estimated to be at least $93 million, excluding cleanup of groundwater Related capital expenditures in the refineries include $52 million for installation of hydrodesulfurization units These figures are based on the closure of two large and two small refineries

ES 1 6 2 Distribution and Marketing

Although not forming part of our study, in our site visits we observed handling problems at the distribution terminals and depots and at the retail sites Based on our observations, we are highly confident that substantial air pollution is occurring through evaporation from rail tankcars and storage tanks and through the lack of vapor handling facilities at loading, unloading and fueling points Based upon the appearance of tanks, we are also highly confident that, due to leaks in above ground and under ground tanks, hydrocarbons are polluting the soil and migrating into the freshwater streams Environmental studies of the distribution and marketing sector need to be conducted

ES 1 7 CRITICAL INVESTMENTS

Consistent with our recommendation to close two large and two small refineries, the summary of the critical investments required are

- $74 6 million for process improvements
- $75 8 million for environmental projects
- $7 0 million to remediate landfills
- $10 5 million to decommission surplus refineries
- $166 3 million for labor redeployment

The determination and calculation of these specific critical investments are presented in detail elsewhere in this report

ES 1 8 NEXT STEPS

The following steps need to be incorporated in the restructuring and rationalization of the Romanian downstream petroleum sector

ES 1 8 1 Concentration of Government Control

Under the existing Romanian industry structure, each of the enterprises is directly or indirectly owned by a combination of the government, via the state ownership fund (or "SOF"), and the populace, via the public ownership fund (or "POF") Government control is exercised through actions of the boards of administration, on which ministry personnel, the SOF and POF serve as directors, and through direct contact between ministry personnel and company executives Administratively, the enterprises are also controlled by the Ministry of Industry and Trade, the Ministry of Finance, and, to a lesser degree, the leadership of the SOF and POF While all of these forms of government influence directly impact the enterprises' business activities and results, no single entity is directly responsible for the entire manufacturing sub-sector Without vesting unified control in a single entity, the rationalization cannot be effectively completed

ES 1 8 2 Equitable Treatment of Shareholders

In addition to the lack of unified control, there is a separate question of equitable treatment of Romanian citizens who have already exchanged certificates of ownership (the vouchers issued by the POF) for shares of common stock in the enterprises in the manufacturing sub-sector Under the rationalization program some of these enterprises will cease to exist These enterprises are being shut down to make the entire sector economically viable, rather than because they are individually non-viable The sector as a whole simply cannot be economically viable so long as all of the surplus capacity continues to be operated This rationalization process creates enormous benefits for the entire manufacturing sub-sector

The value of these rationalization benefits arises from two sources The first source is the closure of the four manufacturing entities The second source represents better operating practices and staffing at the remaining six manufacturing entities Neither the surviving nor the sacrificed groups of manufacturing complexes can be said to have contributed more to the value creation than the other group, both contribute to the process Because both groups contribute to the creation of value for the entire sector, those benefits should be shared by the owners of both groups, not just the owners of the surviving enterprises

Unless some measure is taken, the shareholders of the surviving enterprises would receive all of the benefits of rationalization, although they only contribute part of the value That would be inequitable to the shareholders of the other enterprises sacrificed to make this value possible Thus, all holders of shares in downstream companies should contribute their share to a pool, or a holding company, to be equitably redistributed after the rationalization is completed

ES 1 8 3 Creation of a Temporary, Limited-Purpose Holding Company

To establish the necessary control over the downstream sector, and to allow the rationalization to proceed, we recommend the creation of a holding company The holding company would be granted absolute ownership of all 10 manufacturing enterprises To accomplish this ownership,

all owners of the 10 manufacturing entities would be required to surrender their shares of stock in such entities and receive in exchange shares of holding company stock, making the holding company the sole owner of all 10 enterprises It would also include the SOF and POF So long as the holding company remains in place, any future exchanges of POF certificates of ownership should only involve shares of the holding company and not shares in any of the 10 manufacturing enterprises

As discussed further below, this holding company must be formed for the sole purpose of conducting the rationalization, particularly the shutdowns and decommissioning of refineries, and exist only temporarily to undertake that limited activity Once those activities are completed, the holding company should cease to exist After the rationalization, the holding company shares that were initially issued would be surrendered by their owners and exchanged for newly issued shares in the surviving manufacturing enterprises The end result is that the owners of the original 10 manufacturing enterprises would all become owners in the surviving six enterprises The benefits of rationalization would, therefore, be shared by all of those that contributed to the creation of such benefits

Holding Company Powers. During the holding company's limited life, its management should be given the broad powers that are essential to implement the rationalization program Holding company management should have the power to terminate employment in those four manufacturing complexes that are to be decommissioned, to engage firms to sell the related assets and to scrap unsalable assets, and to cause the four plant sites to be cleaned up in an environmentally responsible manner

Such management should also be given the power to cause the managements of the surviving six manufacturing entities to reduce their staffing to the levels recommended in this report Where possible, the management of the holding company should encourage (but not require) the surviving enterprises to consider hiring the most able employees of the sacrificed facilities, but only with appropriate offsetting staff reductions in those surviving plants In this way the trimmed-down manufacturing sub-sector can retain the most capable employees of the whole sub-sector We recommend that the board of administrators of the holding company consist of directors chosen and empowered in the same manner as the boards of other state-owned commercial companies

Limitation on Holding Company Powers. It is equally important that the management of the holding company not be empowered to engage in any ongoing business activities of an operational nature, those decisions should be left exclusively to the plant managements Holding company management should not be permitted to allocate supplies, production or markets or otherwise plan or oversee any of the operational or administrative activities of the surviving plants They should have no role in operational decision-making or in administration of the surviving manufacturing complexes They should not be permitted to establish prices for any crude oil or any products They should not be empowered to fire or replace any of the management of the manufacturing complexes for any reason [other than failure to carry out the

restructuring and rationalization] They should not engage in any negotiations for supplies, pricing, or for services involving the manufacturing complexes and PECO, PetroTrans, Petrom, CONPET or any other suppliers or customers They should not be permitted to use funds of any surviving manufacturing complex to subsidize the losses of any other surviving manufacturing complex or to perpetuate the continuation of operations at the sacrificed manufacturing complexes Such funds should, however, be made available to fund the decommissioning and staff reductions at the sacrificed manufacturing complexes

We considered and rejected the idea that the holding company should include other downstream sector entities such as PECO, PetroTrans, PetrolExportImport, Oil Terminal and CONPET Because none of those enterprises are being shut down or significantly downsized, there is no need to include them in the special-purpose entity Each of those entities, acting alone, is capable of managing its own transformation By excluding them from the holding company any temptation toward further vertical integration of the sector can be avoided Obviously, other government policy changes (through ordinances and through actions by NAMR) will be necessary to enable the managements of those companies to operate their business in accordance with market principles and our recommendations However, the holding company cannot and should not make those changes and would be an unnecessary impediment to their accomplishment

Funding of Holding Company Activities To fund the necessary plant closures and terminations of employment, the holding company should be entitled to utilize a portion of the proceeds from asset sales of the closed plants and be allowed to retain a portion of the proceeds from any rationalization loans that are attributable to the shutdown, decommissioning and employment termination programs for the four manufacturing complexes that are to close

The holding company should not be allowed to take possession of any loan proceeds that are intended to fund the staff reductions or investment projects at the surviving manufacturing entities Management of those manufacturing entities should be empowered to spend such funds Further, the holding company management should not be entitled to retain any dividends paid by the manufacturing enterprises other than such reasonable amounts as may be necessary to cover their ongoing costs of salaries, occupancy, etc , as approved by the board of administrators

Limited Life of the Holding Company. The holding company should expressly be chartered to exist for a pre-defined and finite period of time, not to exceed four years At the end of three years, if any remaining rationalization steps have not been carried out, the holding company should at that time enter into a contract with one or more private-sector enterprises to carry out all remaining steps At the end of the four-year period, the shares of the holding company held by Romanian citizens and the SOF and POF should be exchanged for shares of the surviving manufacturing complexes At that time, any unfinished contracts or restructuring and rationalization steps should be assumed by the SOF

Staffing of the Holding Company Overall, we believe the holding company staff should not exceed 20 managers and employees, all of whom should have appropriate qualifications and knowledge of the refining, petrochemicals or lubricants businesses All other services should be fulfilled by private-sector enterprises under contracts with the holding company

Compensation and Termination Benefits To motivate the management of the holding company and the enterprises to accomplish the difficult tasks of achieving the rationalization objectives within the three-year period, we strongly recommend that incentive compensation be awarded to their management

ES.1 9 CRUDE OIL TRANSPORTATION (CONPET)

Our refinery rationalization strategy will eliminate four refineries The elimination of barter processing of crude oil will substantially reduce the need to import crude oil Collectively, these changes will reduce the overall length of pipelines needed to supply the refineries, reduce the pipeline throughput, and simplify the crude oil pipeline system Thus, CONPET's needs for capital to refurbish and upgrade its system will be reduced

CONPET operates two pipeline systems, an import pipeline system and a domestic pipeline system The import pipelines move imported crude oil from the Constanta harbor to the refining sites The domestic pipelines move crude oil from Romanian oil fields to the refineries Both pipeline systems are in deplorable condition due to inadequate investment and obsolete pipeline control systems Severe crude oil losses are occurring due to leakage from corrosion-damaged lines Such losses are difficult to quantify and control because of the poor state of metering instrumentation and transmission controls

The simplification of the crude oil transportation system and the reduction in the volume of transported crude oil will lower certain of CONPET's operating costs Energy used in pumping will decline as a result of reduced crude volume Maintenance requirements will drop as a result of lower pumping operations and the reduced length of the pipeline systems The simplification of the pipeline system and the reduction of overall length of lines in service will reduce CONPET's scope of activities Accordingly, operating and administration staff reductions will be possible, leading to reduced personnel costs

CONPET's tariffs for transportation will need to be revised to reflect both the smaller total costs and the lower volume to be transported Despite the economies described above, there is a large "fixed" component in total pipeline costs Accordingly the significantly lower volumes to be transported are likely to increase the average per-ton tariff CONPET must receive We have not quantified the net impact on CONPET's tariffs

ES 1.10 ACTION ITEMS

The foregoing summary sets forth the key elements of the Rationalization and Critical Investments portions of our Downstream Restructuring Strategy for Romania The crucial elements of the rationalization are set forth below

1 **Price Decontrol:** Decontrol all pricing of crude oil, refined products, petrochemicals and lubricants over as brief a period as possible

2 **Holding Company:** Establish a special-purpose, limited life holding company for the rationalization of the 10 manufacturing complexes and enforce implementation of the rationalization steps described herein, including the workforce reductions described below

3 **Refinery Closures** Permanently close and decommission four refineries and merge Darmanesti into Rafo

4 **Petrochemicals Shutdowns** Permanently close all petrochemicals units at Petrobrazi and Petrotel and selected units at Arpechim

5 **Lubricants Consolidation:** Permanently close and decommission all lubricants manufacturing at Arpechim, Steaua Romana and Vega Consolidate all lubricants production, cut costs and improve operating and management practices at Astra and Petrotel If, after those measures have been implemented, the lubricants business at those sites is still not profitable, close those as well

6 **PECO and PetroTrans:** Eliminate PECO's requirement to purchase only through PetroTrans and permit it to source directly from refiners Convert PetroTrans from a "merchant" transporter to a service-based transporter only PetroTrans' pipelines should be made into common carriers with rate-based tariffs based upon distance and other criteria Railcar and truck transport should be deregulated as to price and service

7 **Regulatory Oversight:** Establish a regulatory function to establish and enforce quality measurement and environmental standards

8 **Workforce Reduction** Implement the workforce reduction program at all manufacturing complexes through early retirements and termination programs and outsourcing of maintenance functions Reduce the impacts on displaced workers through severance payments, jobs training and relocation assistance Perform a similar analysis in the distribution and marketing sub-sector and implement those programs as well

9 **Environmental Restoration and Remediation:** Implement the environmental program to reduce further pollution of air and land and to begin the cleanup of past environmental contamination

10 **Operating and Management Practices** Throughout the sector, design and implement corporate development programs to improve work processes, operating

practices and management methods through modern organization structures supported by appropriate information systems In particular, develop programs to measure and improve customer service, measure and report on economic performance of each profit center within each company, and develop appropriate plans and targets to dramatically improve efficiency, productivity and profitability of the companies

ES 1 11 CONCLUSION

Profitable operations are essential for this sector to be able to generate and attract capital to restore, maintain, and improve its abilities to serve customers at acceptable levels Each of our recommendations seeks to contribute to making the state-owned enterprises profitable and competitive on a long-term basis

All of the foregoing, plus additional steps identified throughout this report and the related detailed reports, should be implemented Only through such fundamental and radical measures can Romania expect to restore the downstream sector to profitable operations which will enable it to contribute to the economic growth of the country by bringing high-quality products to those at the necessary places and times needed and at reasonable costs

Section 1

Market Demand and Prices

This section contains a presentation of the expected demand for petroleum products in Romania and the anticipated market prices In preparing our projections, we knew that future demand would ultimately be compared with existing capacity and used to recommend shutdowns of refining capacity To avoid premature shutdowns, in our projections we deliberately sought to err in favor of higher demand, while still remaining within the bounds of reasonableness This results in a slightly optimistic view about the need for refinery capacity over the 10-year period

In addition to demand for refined products, we also projected future demand for petrochemicals to assess the need to maintain existing capacity Also, to support economic modeling, we obtained projections of future prices for oil and refined products Because petrochemicals prices are cyclical and often erratic we did not prepare or obtain projections about future prices for them, but instead based all of our economic analysis on flat prices at mid-1995 levels

Romania currently maintains refinery production levels and capacity far above both current needs and projected demand for refined products over the next decade This, in turn, leads to waste and inefficiency which are reflected in high per-unit costs To support those excessive refining costs, the refiners are subsidized, oil producers are deprived of market prices, and consumers are required to pay too much for refined products But, despite these subsidies, refiners themselves are unable to generate enough capital to reinvest in modern and productive equipment and technology and, at present, remain uncompetitive by world standards To achieve economic viability without reliance on subsidies, refining capacity clearly must be rationalized to better fit the demand within Romania Accordingly, we conducted an analysis of future market demand for refined products based on open market conditions

1.1 MACROECONOMIC TRENDS

Future product demand will be heavily influenced by general economic conditions in Romania In 1995, the Romanian economy was projected to grow approximately 3 0% over 1994, reflecting the third year of growth after hitting a low in 1992 The recent turnaround in the Romanian economy, with over 30% of the gross domestic product (GDP) now contributed from the growing private sector, is evidence of a successful beginning for the transformation of the economy from a highly planned, heavy industry-oriented system to a partly privatized, service and consumer oriented economy

The outlook for GDP growth for the next decade is directly linked to expectations about the pace and degree of wide-scale privatization efforts Privatization has already attracted foreign capital and is expected to continue to do so in the future Figure 1-1 shows 1996 and beyond, a projected annual economic growth of 4 0% per year This level of growth, while faster than expected global trends, is considered achievable on a sustained basis if current economic improvement efforts are maintained or accelerated and the private sector continues to take on more of the nation's output at a relatively brisk pace

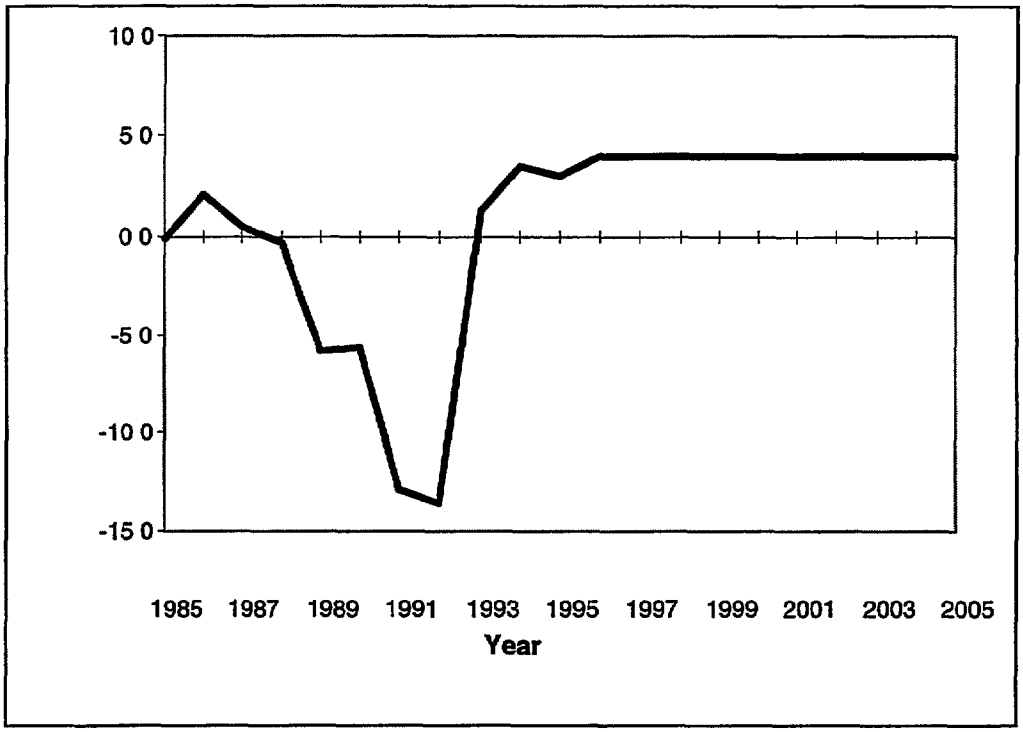

Figure 1-1 Romanian GDP

1 2 REFINED PRODUCTS DEMAND

Table 1-1 below presents the outlook for refined products demand in Romania Overall, demand is expected to grow at 3 0% per year from 1995 to 2000 and 2 7% per year from 2000 to 2005 Total demand is expected to grow from 14 8 million metric tons (MMT) in 1995 to 17 2 MMT in 2000 and 19 6 MMT by 2005

Table 1-1
Refined Product Demand

	Thousand Metric Tons			Average Growth		
	1995	2000	2005	'95-'00	'00-'05	'95-'05
				%	%	%
Unleaded Gasoline	347	681	1,695	14 4	20 0	17 2
Leaded Gasoline	1,603	1,691	1,333	1 1	-4 6	-1 8
Total Motor Gasolines	**1,950**	**2,372**	**3,028**	**4 0**	**5 0**	**4 5**
High Sulfur Diesel (2% S)	912	800	471	-2 6	-10 1	-6 4
Low Sulfur Diesel (1- 05% S)	2,483	3,330	4,554	6 0	6 5	6 3
Total Diesels	**3,395**	**4,130**	**5,025**	**4 0**	**4 0**	**4 0**
Low Sulfur Fuel Oil (1% S)	1,448	1,855	3,717	5 1	14 9	9 9
High Sulfur Fuel Oil (3 5% S)	4,028	4,044	2,332	0 1	-10 4	-5 3
Total Fuel Oils	**5,476**	**5,899**	**6,049**	**1 5**	**0 5**	**1 0**
LPG	440	522	577	3 5	2 0	2 7
Naphtha	177	215	275	4 0	5 0	4 5
Duel Purpose Kerosene	390	463	550	3 5	3 5	3 5
Lube Base Stock	350	406	448	3 0	2 0	2 5
Coke for Export	280	309	333	2 0	1 5	1 7
Coke for Domestic Use	1,570	1,624	1,677	0 7	0 7	0 7
Bitumen	389	402	415	0 7	0 7	0 7
Miscellaneous	428	508	604	3 5	3 5	3 5
Other	0	333	675	n/a	n/a	n/a
Total Other Products	**4,024**	**4,782**	**5,554**	**3 5**	**3 0**	**3 3**
Total Products	**14,845**	**17,184**	**19,657**	**3 0**	**2 7**	**2 8**

Petroleum product demand in the next decade is expected to shift significantly toward the lighter end of the barrel as a result of continued economic transformation and improved disposable income Growth rates for transportation fuels are projected to be much stronger than those for the heavier products traditionally employed in heavy industries and the power sector This shift is further reflected in the changing percentage of clean versus high-sulfur product, which is expected to grow from 43% by 1995 to 45% in 2000 and 48% by 2005 Even with the projected further growth in light petroleum products during the next 10 years, fuel oil demand is still projected to represent a relatively large portion of total petroleum product demand

Gasoline demand in Romania is expected to grow at 4 0% per year through 2000 and 5 0% thereafter, reflecting the improved levels of personal disposable income resulting from healthy GDP growth Demand for gasoline will reach 3 0 million metric tons by the year 2005 The pace of the adoption of unleaded gasoline by motorists is influenced by several factors that are currently difficult to predict in Romania The most important of these factors is the timing of Romania's acceptance into the European Union (EU) Membership in the EU, among other things, would require adherence to specific quality targets for petroleum products including

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elimination of leaded fuels Another important factor affecting unleaded gasoline demand is the availability of passenger automobiles with catalytic converters Because automobiles are particularly expensive in Romania, it is very likely that consumers will retain their existing vehicles longer Such consumers will probably favor cheaper pre-owned, leaded-gasoline imported cars rather than new vehicles, which use unleaded fuel Overall, it is unlikely that a more dramatic, shift away from leaded gasoline will occur Demand for **naphtha**, while representing a relatively small fraction of total demand, is expected to continue growing as petrochemical demand rises to meet rapidly increasing consumer demand Naphtha demand is projected to grow at 4 0% per year from 1995 to 2000 and then 5 0% per year thereafter

Diesel demand, which is projected to grow to 4 0% per year, is also expected to shift from industrial use toward transportation uses Diesel demand is projected to reach 5 million metric tons by 2005 High-sulfur diesel is expected to decline over the period, dropping 2 6% in the first five years and 10 1% thereafter as environmental pressure forces elimination of sulfur and industrial usage is expected to decline as heavy industry is shut down or re-oriented toward consumer products production Low sulfur diesel in expected to grow 6 3% per annum In 1995, low-sulfur diesel represents 73% of diesel demand Its share is projected to increase to 91% by 2005

Fuel oil demand is projected to be the slowest growing among petroleum products, rising by only 0 6 million metric tons over the decade, to reach 6 million metric tons in 2005 High-sulfur fuel oil demand is projected to remain flat though 2000 and to start declining significantly (10 4% per year) thereafter Romania's electricity demand is projected to be quite robust in the next few years due to direct increases in disposable income Romania may prefer to meet this growing power demand with clean fuels, such as natural gas, rather than high sulfur fuel oil, their traditional power generation fuel However, the effects of switching to natural gas are not expected to displace significant demand for fuel oil during the next decade because the necessary gas transmission infrastructure for high-volume, sustained delivery of natural gas to power plants is not expected to be in place Due to revitalized light manufacturing activity and the country's short-term infrastructure development, total demand for fuel oil is projected to remain at current levels through 2000 High-sulfur fuel oil demand, however, is projected to remain flat though 2000 then decline significantly (10 percent per year) from 2001 through 2005 as the privatization and heavy industry rationalization processes result in the closure or conversion of most fuel-oil-intensive industrial assets

Demand for the **remaining products** (miscellaneous and other) is projected to closely track GDP growth and grow at a combined average annual rate of 3 5% per year from 1995 through 2000 and at a rate of 3 0% per year thereafter The miscellaneous category includes volumes of other products which are currently being sold in Romania The category of other products represents the additional amount of unspecified product sales which are required to match the sum of individual product categories to the overall demand projection **Lube base stock** is projected to be a moderately growing product in this category

1 2 1 Refinery Capacity Implications

The economic models used to evaluate the refineries are based upon the product demand projections presented above and the product price and differential forecasts of Bonner & Moore (presented in the next section) The modeling approaches used identified the proper mix of capacity utilization and yield which takes greatest advantage of domestic production or imports to derive the lowest cost of making or buying products Although each element is important to some degree, the most important dimension in the study is product demand

To the extent that future demand was projected to be too low, surplus capacity would be overstated and there would be a risk that our modeling would recommend premature closure of a refinery To the extent that future demand was projected to be too high, there would be a risk that a desirable refinery closure would not be recommended For these reasons, in this study we concluded that the demand forecast should be based upon reasonable assumptions However, where possible, we concluded we should err in favor of an optimistic view of demand growth In this way, no refinery would be recommended for closure if there was a reasonable prospect that its capacity would be needed to meet demand in the mid term

Figure 1-2 below shows the implications on capacity needs assuming the demand projection used in our analysis was too high or too low by up to 3% per year over the entire 10-year period Clearly, even a large error in the demand projection represents a capacity impact which is smaller than the capacity of one of the large refineries

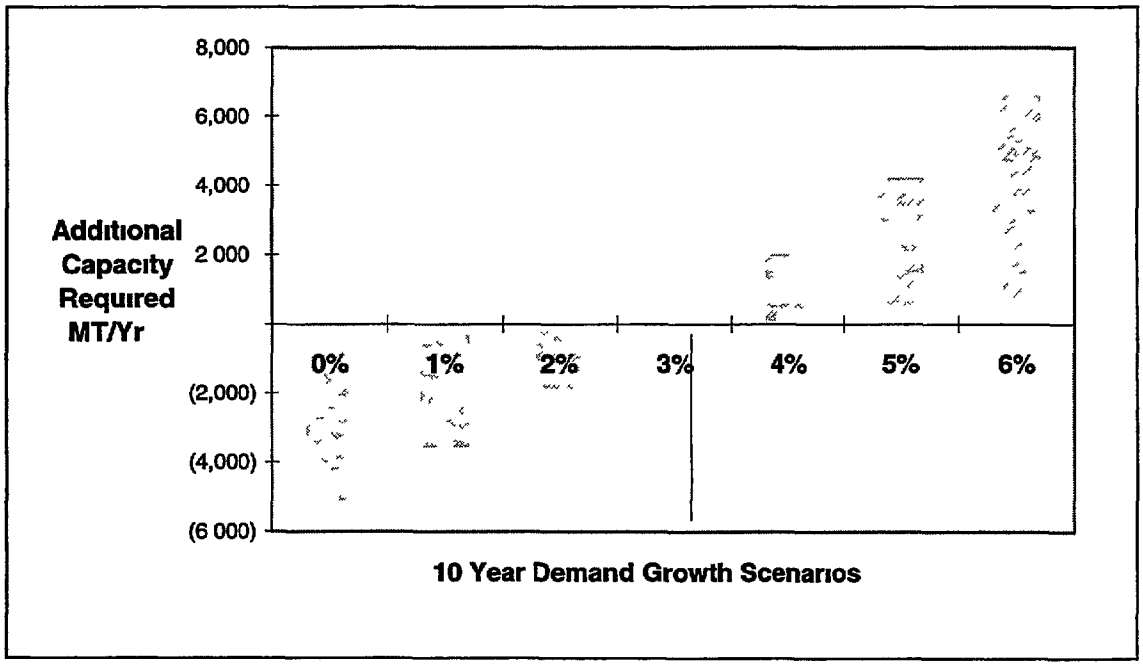

Figure 1-2 Refinery Capacity Sensitivity Analysis

GDP growth would have to improve significantly, nearly doubling to a sustained rate of nearly 7% per year from 1995 to 2005, to justify the need for a single additional refinery In our view, growth rates at that level are simply not possible because the overall economy has so much industrial restructuring still to come Accordingly, the economy will continue to experience downward pressure on "old" economic output at the same time "new" growth is occurring On balance, a 4 0% sustained rate of growth in GDP will itself be difficult, but still possible We believe that it is reasonable to premise decisions about Romania's refining capacity needs on growth at this level, but not higher

1 2 2 Refined Product Mix

The actual level of economic growth will combine with other factors to shift the slate of products demanded Over the next decade, industrial additions of new plant and equipment will use more modern technology, energy intensive industries will continue to be displaced by lighter manufacturing, and the electric power sector will alter its energy supplies All of these trends will permanently shift demand away from heavy fuels and toward lighter products or alternate fuel sources

The fuels mix will also be impacted by environmental concerns and the drive to meet European Union guidelines for cleaner air standards These will increase the demand for low-sulfur fuels and diminish the demand for high-sulfur fuels Lastly, as Romanian society becomes more affluent, consumer demand for personal automobiles will be met with new automobiles Most of these new automobiles will require low-sulfur diesel or unleaded gasoline and, when combined with the retirement of older automobiles, will shift motor fuel requirements from leaded to unleaded gasoline and to low-sulfur diesel Romania's new Dacia automobiles, for example, are now equipped with catalytic converters to protect the environment and these must be powered using unleaded fuels Table 1-2 shows the charging allocation fuels over the next 10 years

Table 1-2
Cleaner Fuels

	1995	2000	2005
	%	%	%
Unleaded Gasoline	17	28	55
Leaded Gasoline	83	72	41
Subtotal Motor Gasoline	**100**	**100**	**100**
High Sulfur Diesel (2% sulfur)	27	19	9
Low Sulfur Diesel*	73	81	91
Total Diesel	**100**	**100**	**100**
Low Sulfur Fuel Oil (1% sulfur)	26	31	61
High Sulfur Fuel Oil (3 5% sulfur)	74	69	39
Total Fuel Oil	**100**	**100**	**100**

* 0 1% sulfur to 2000 0 05% sulfur thereafter
Source International Energy Agency for major product category demand
PECO for 1995 major product quality distribution

1.3 PETROLEUM PRICES

Price expectations are primarily used to develop the economic analysis of the refining complexes, particularly the refineries and petrochemical plants During the 10-year period covered in this study, price increases are not expected to significantly influence either Net Present Values or demand All underlying price forecasts for oil and refined products were developed by the energy consulting firm of Bonner & Moore Transportation costs, based upon international market tariffs, adjusted for distance, were added to adjust the petroleum prices to reflect market levels delivered in Romania

Our projection of petroleum product demand is based on Bonner & Moore's crude oil price expectations of relatively flat real world crude oil prices through 2005 Crude oil price assumptions used in our analysis included Brent, Iran Light, Iran Heavy, Urals, Libyan, Dubai, and Suez Blend Prices of these crudes are shown in Table 1-3 below

For both crude oil and refined products, prices available in the Mediterranean market were adjusted for transportation cost Transport cost consisted of an ocean freight component and an overland tariff-based component The transport adjustments normalize the inherent advantages Romanian refineries have as a result of proximity to their markets and give a realistic competitive import product cost of "Mediterranean prices plus transport "

Table 1-3
Mediterranean Crude Prices
$ per ton

	1995	2000	2005
Brent	125	132	140
Iran Light	117	119	125
Iran Heavy	112	112	116
Urals	116	119	125
Libyan	123	129	136
Suez Blend	111	108	113
Dubai	115	117	122
Nat'l Gas (FOE)	151	155	163

1.3.1 Crude Oil Prices

The general outlook for Brent crude oil prices by Bonner & Moore anticipates that constant U S dollar prices for Brent crude oil will increase only modestly, at an average annual rate of $1 50 per ton through the year 2005 and, in aggregate, will rise from $125 per ton in 1995 to $140 per ton by 2005 Brent prices are projected in Figure 1-3 below

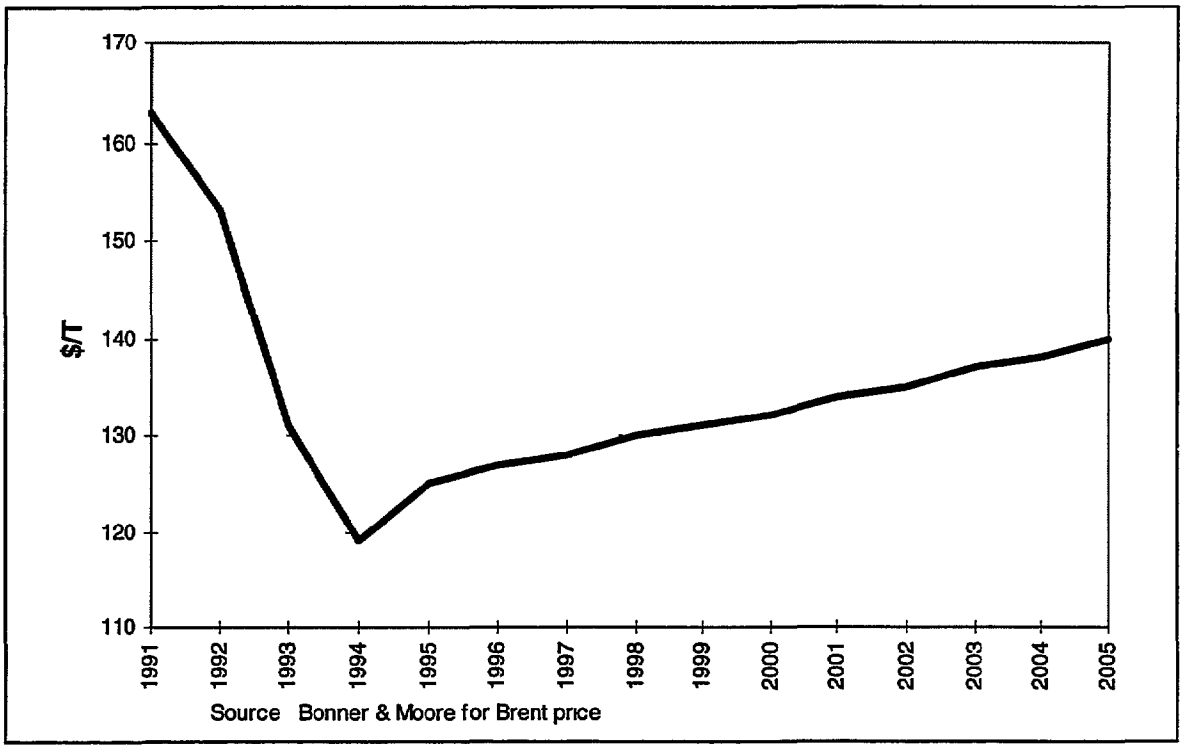

Figure 1-3 Real Brent Prices ($/ton Delivered at Constanta)

The scope of our analysis did not include analysis of different crude oil price scenarios (high or lower prices within a reasonable level) It is our opinion, however, that Romania's vulnerability to changing world oil prices in the next decade is lower than in most other countries Industrialization in South East Asian countries, for instance raises there reliance on oil and makes those countries highly vulnerable to changes in crude oil prices In Romania, the industrial sector will continue to convert from heavy to light manufacturing over the coming decade -- a process which reduces its vulnerability to energy prices

1 3 2 Refined Products Prices

The price projections for products in the Mediterranean were provided by Bonner & Moore These prices, without transportation added, are shown in Table 1-4 below for the 24 major refined products found in the Romanian market

Table 1-4
Mediterranean Refined Products Prices
$ per Ton

	1995	2000	2005		1995	2000	2005
LPG	111	111	111	Diesel 2%	146	163	173
87 RON Leaded Gasoline	151	164	174	Diesel 05%	151	173	183
87 RON Unleaded Gasoline	152	163	175	Gasoil	141	158	168
95 RON Leaded Gasoline	166	179	193	Fuel Oil 3 5%	84	86	91
95 RON Unleaded Gasline	165	178	192	Fuel Oil 1 0%	97	100	104
97 RON Leaded Gasoline	170	183	196	Fuel Coke	17	18	19
98 RON Unleaded Gasoline	185	199	215	Anode Coke 1%	85	90	95
Methanol	165	178	190	Needle Coke	225	238	251
MTBE	297	320	342	Bitumen	25	26	28
NAPHTHA	141	156	175	Lube Base Stock	365	386	407
Kerosene	152	173	185	Propane	171	156	170
Jet Fuel	153	174	186	Butane	162	159	171

Bonner & Moore provided the following comments about the Mediterranean market for refined products

1 3 3 Gasoline

- Octane capacity is likely to be sufficient, with only a modest widening in **gasoline quality premiums** 98 RON leaded gasoline will continue to be at a premium relative to 95 RON unleaded gasoline in the Mediterranean
- The differential between **naphtha** and regular unleaded gasoline narrowed to about $30 per ton in 1995 Growth in petrochemical consumption worldwide should continue to outpace that for gasoline, further reducing the naphtha/regular-unleaded gasoline differential to $22 per ton by 2005

1 3 4 Distillates

- **Gasoil margins** to Brent are also projected to increase by a net $12 per ton from 1995 to 2005
- Price differentials for diesel with a sulfur content of 0 2 wt% sulfur will steadily widen, relative to the standard European Union gasoil product priced in the

Mediterranean, to $15 per ton in 2005, reflecting transportation costs to move the product to distant export markets

- The differential between jet kerosene and gasoil also narrowed from $24 per ton in 1989 to $12 per ton in 1994 In real terms, the jet kerosene/gasoil differential is projected to widen to $18 per ton by 2005

1 3 5 Fuel Oils

- By 2005, the fuel oil differential is projected to be between the 1993 and 1994 levels per ton
- In 1993, 3 5 wt% sulfur fuel oil prices in the Mediterranean were $71/per ton below the dated Brent crude oil price The differential was reduced by almost half, to $41-44 per ton in 1994 and 1995
- The differential between 3 5 wt% sulfur fuel oil and Brent is projected to widen steadily to $49 per ton by 2005 The differential between 1 0 wt% sulfur fuel oil and 3 5 wt% sulfur fuel oil decreased from $30 per ton in 1993 to an estimated $13 per ton in 1995 As bunker fuel consumption is expected to increase in contrast to the decline in boiler fuel usage due to natural gas substitution, the differential is likely to remain narrow in historical terms with a value of $14 per ton projected for 2005

1 4 PETROCHEMICAL DEMAND

Consumer demand for petrochemical-based products drives both petrochemical plant capacity requirements and refinery naphtha demand Domestic demand has been projected for each petrochemical product based upon current shipments to each domestic customer group and upon the projected growth rates for each group For certain low-volume customer groups, including ink and dye manufacturers, growth rates are not available and, in these cases, the projected Romanian GDP annual growth rate of 4 0 percent has been assumed

As shown in Table 1-5, export demand growth for petrochemicals was estimated assuming that exports will escalate at a rate corresponding to the average annual projected GDP growth rate for Europe as a whole, roughly 3 4 percent through 2000 and 3 2 percent thereafter

Table 1-5
Petrochemical Demand (Thousand Tons Per Year)

	Domestic			Export			Total			10 Year Average Growth Rate		
	1995	2000	2005	1995	2000	2005	1995	2000	2005	Domestic	Export	Total
										%	%	%
Ethylene Derivatives												
LDPE	34 6	43 8	55 3	19 5	23 0	26 9	54 1	66 7	82.2	4 8	3 3	4 3
HDPE	18 3	23 1	29 2	3 7	4 4	5.2	22 0	27 5	34 3	4 8	3 5	4 5
Ethylene for PVC Export				67 2	79 2	92 6	67 2	79.2	92 6	0 0	3 3	3 3
Other	25.8	34.3	45.7	2.6	3.1	3.6	28.4	37.3	49.2	5 9	3 3	5 6
	78 7	101.2	130.2	93 0	109 7	128 3	171 7	210 7	258 3	5.2	3 3	4 2
Propylene Derivatives												
Polypropylene	14 6	18 4	23 3	15 2	17 9	20 9	29 7	36 3	44 2	4 8	3 2	4 1
Acrylonitrile	24 3	36 9	36 9	49 4	58 3	68 1	73 7	95.2	105 1	4 3	3 3	3 6
Other	20.4	29.6	43.4	1.4	1.7	2.0	21.9	31.3	45.3	7 8	3 6	7 5
	59 3	84 9	103 6	66 0	77 9	91 0	125 3	162.8	194 6	5 7	3.3	4 5
Aromatics and Derivatives												
Benzene sales	7 4	10 1	12.5	3.3	3 9	4 6	10 7	14 0	17 0	5 4	3 4	4 7
Toluene sales	18 9	29.2	36.5	7 0	8.2	9 6	25 9	37 5	46.2	6 8	3.2	6 0
Anhydrides + DMT	21.0	31.6	47.6	45.9	54.0	63.2	66.9	85.8	110.8	8 5	3 3	5.2
	47.3	70.9	96 6	56.2	66 1	77 4	103.5	137 3	174 0	7 4	3 3	5 3
Carbon Black	16.3	21.9	29.5				16.3	21.9	29.5	6 1	0 0	6 1
Total	201 6	278 9	359 9	215.2	253 7	296 7	416 8	532.7	656.4	6 0	3 3	4 6

1 5 PETROCHEMICAL PRICES

International market prices of petrochemicals vary widely from year to year based upon global supply and demand patterns Globally, demand follows overall economic growth trends Capacity, however, is added erratically, usually through construction of very large, world-scale plants which are constructed during and immediately after a surge in product prices As major capacity is added, global prices fall to lower levels

In our analysis of the manufacturing complexes and petrochemical operations, we did not project future prices Instead, we based all of our analysis on flat prices at the levels shown in Table 1-6 below

Table 1-6
Petrochemical Prices

Delivered in Romania

Ethylene Derivatives	$/T	Aromatics and Derivatives	$/T
LDPE	913	Benzene sales	344
HDPE	844	Toluene sales	216
MEG	693	Maleic Anhydride	1,189
Propylene Derivatives		Phthalic Anhydride	1,471
Polypropylene	913	DMT	1,174
Acrylonitrile	1,280	**Carbon Black**	450
Phenol	863		
Acetone	621		

Prices shown above have generally declined since our analysis was performed We believe our conclusions about the economic viability of the petrochemical operations would not change if current prices had been used instead of those presented above

Section 2

Manufacturing Sub-Sector

The manufacturing sub-sector includes integrated complexes consisting of refineries, petrochemical plants and lubricant plants In general, refineries provide feedstocks to the other two, but in some cases petrochemical and lubricant plants sell products back to the refineries and, in other cases, petrochemical and lubricant plants obtain feedstocks from other sources

2 1 PRESENTATION FORMAT

This manufacturing section consists of the following components **Key Findings and Recommendations** present our findings for the consolidated Refining, Petrochemical and Lubricants industry sub-sectors Each of the recommendations and key findings included in this section is covered in more detail in either the **Refining, Petrochemical** or **Lubricant** sections Those sections also contain additional detail on the methodologies employed, calculations, data and analysis commentary

Several economic terms are used extensively in this report For clarity, they are defined below

Real Prices/Costs Also referred to as "Constant Dollar" expenses and costs This term indicates future prices or costs which exclude future inflation For example, if the price of oil is $150 per ton on January 1 and during the year inflation is 10%, making the price $165 per ton at year end, then market prices have not changed, apart from inflation Our analysis ignores inflation and would price oil at both points at $150 per ton

Net Present Value (NPV): The term "Net Present Value" is used to indicate today's value of a series of future annual cash flows adjusted to reflect the time value of money at a discount rate (or interest rate) It is expressed as the single dollar amount required today to exactly equal, from an economic perspective, the value of an entire series of future cash flows NPV is dependent upon the prevailing rate of return or discount rate used to compensate for the time value of money As these rates increase, cash flows in the future have diminished value from an NPV perspective In all the NPVs presented herein, an annual discount rate of 10% was used This rate is considered reasonable since the cash flows to be discounted do not include inflation All future revenues and costs of feedstock are priced at international market prices, using U S dollar equivalents for Lei costs

2.2 SUMMARY OF KEY FINDINGS AND RECOMMENDATIONS

In manufacturing, the overwhelming problem is that refining utilization rates are unsustainably low Romania possesses about twice as much refining capacity as it needs Realistically, there is simply no way for Romania to economically utilize this surplus capacity because

- toll processing into the export market is structurally uneconomic,
- it is much cheaper to buy fuel oil than to manufacture it domestically, and

- despite robust growth, future domestic demand for other products is far too low to use the surplus capacity

Despite this under-utilization of capacity, all 10 Romanian refineries continue to operate, putting the cost burden of an inefficient 33 million tons-per-year sector onto 12 million tons per year of refined oil To support this inefficiency, subsidies are provided Consumers pay too much and oil producers are paid too little, and still the refiners are unable to generate sufficient capital to modernize and improve

Unless these conditions are changed, the refining sub-sector will continue to decline, imposing undue economic burdens on the Romanian economy and discouraging the private-sector investment which could restore the sector to profitability To cure these structural problems, two large refineries and two small ones should be decommissioned, and cost structures and operating practices in the remaining operations should be dramatically improved

In addition to the problems in refining, there are important but smaller problems elsewhere in the sector Petrochemicals are basically sound but are burdened by certain assets which are not viable Lubricants are losing money and require many changes, but potentially can become profitable, at least for the short term

In petrochemicals, a sustainable core of assets is encumbered by uneconomic plants and units, some of which use obsolete technology, some of which operate at an uneconomic scale, and the rest of which are either redundant or depend on refineries that are themselves not viable The losses attributable to the uneconomic plants and units are consuming the profits from the viable activities These uneconomic plants should be closed, and operating practices at the remaining plants should be modernized to improve performance The petrochemical business is also distorted by price controls In some cases products sell at prices that are higher than international market levels, and in other cases the prices are below market All prices should be based upon market supply and demand, not government control

Lubricants manufacturing is plagued by poor technology which produces products of inferior quality that are made worse through contamination during the distribution process The private vehicle engine oil market segment has been largely lost, perhaps permanently, to foreign manufacturers who so far have penetrated only that market segment Romanian lubricant manufacturers are now only able to serve a market consisting of state-owned industrial, military and commercial entities because those customers are willing to tolerate the lower quality of the products offered In the future, those customers are also expected to demand higher quality and service This will pose the threat that the remaining market of Romanian lubricant customers will also be captured by foreign companies Accordingly, this sub-sector, which currently is not profitable, faces probable economic extinction in the future unless operating and distribution practices are made commercially viable To restore potential viability, three small lubricant facilities should be closed and their production consolidated into the other two For the

survivors, cost structures should be dramatically lowered and operating practices should be modernized

2 3 KEY FINDINGS AND RECOMMENDATIONS – SECTOR OPTIMIZATION

Based upon market prices of crude oil, refined products, petrochemicals and lubricants, the manufacturing sub-sector is currently losing huge sums of money Overcapacity, low operating rates and excessive employment are combining to destroy the sub-sector's ability to generate economic value If the worst practices are eliminated, the sector's results can be improved from negative to marginally positive We estimate that continued operation of the five large manufacturing complexes (Arpechim, Petrobrazi, Petromidia, Petrotel and Rafo) as they were run in 1994 would result in an economic NPV of negative $2,572 million at market prices This is equivalent to a drain on the overall Romanian economy of roughly $305 million per year, or nearly $1 million per day

2.3 1 Negative Effects of Price Distortions

The financial statements of the five largest refineries show a profit of 189 billion Lei in 1994, roughly equivalent to $118 million However, only tremendous subsidies from other sectors of the economy made this positive result possible Domestic crude is now sold to the refineries at prices which are about one-third below international market equivalents Many refined products are sold at refinery gate prices which are substantially above international market equivalents Gasoline prices, for example, are up to $100 per ton above market prices These price distortions combine to produce a cross-subsidy from other sectors of the Romanian economy to the refining sector that we estimate totaled $499 million in 1995 for all 10 refining complexes The 1995 cross-subsidy from Petrom, the state-owned producer, is estimated to be $269 million annually The 1995 cross-subsidy from consumers and industry who are paying too much for petroleum products is estimated to be $230 million per year In petrochemicals, some products are priced below market and others are priced above market, but on balance we estimate that other industries are subsidized by this sub-sector at an annual cost of $55 million In total, the net effect of these cross-subsidies is $444 million per year into the downstream sector, an aggregated cost of almost $12,000 per year for each employee directly employed in petroleum manufacturing All price distortions lead to suboptimization in the economy These refining cross-subsidies raise oil imports by depriving the oil producer of market prices and depress economic output through high imports, overcharges to consumers and waste and inefficiency in the sector

2 3 2 Losses Generated by Processing Imported Crude for Re-export

Currently, crude processing volume in Romania is inflated because of the uneconomic level of "toll" processing Barter processing, a form of toll processing, is being used to generate

sufficient export products to pay for 50% of the cost of imported crude oil Although it moderately reduces hard currency imports, this practice leads to large economic losses

The extremely large Mediterranean trading center dominates the import and export prices for crude oil and, especially, refined products Many highly efficient regional refineries push their surplus products into the Mediterranean market They do this not to earn profits as exporters, but instead as a way of disposing of surplus products which they do not need to serve their home markets These sales are based on incremental economics, they do not allow recovery of full costs, or even variable costs of processing As a market of last resort, prices in the Mediterranean spot market are quite low The net refining margin inherent in Mediterranean product prices has been negative for many years We project this situation will continue at least through 2005, probably longer This means that no Romanian refinery, not even Petromidia, can expect to process imported oil with the expectation of exporting the refined products at a sustained profit

Shown in Table 2-1 below is an analysis of the economies of purchasing 100 0 tons of crude oil and refining it into refined products (losing 11 2 tons through fuel use and loss), and selling the resulting products (88 8 tons) in the Mediterranean market All yields, prices and costs are based on actual data for Romania's five large refineries and on market prices in 1995 As the table shows, crude costs are $127 35 per ton while the products sell for only $117 72 per ton, yielding a gross margin loss of $9 62 per ton before any operating costs are included Variable operating costs are $2 60 per ton, bringing the total net margin loss to $12 22 per ton overall This case clearly demonstrates the Romanian refineries cannot profitably process imported oil to resell refined products in the Mediterranean market

Reductions of either fixed or variable costs will not reverse the above negative margins and make toll processing attractive The value of products refined and sold ($117 72 per ton) is significantly below the cost of crude oil ($127 35 per ton), thus, no matter how much variable or fixed costs are reduced, they will always be greater than zero and will further reduce the already negative gross margin Similar results are experienced by all refiners that sell into the Mediterranean market

Table 2-1
Case 1 Import 100 Tons of Crude and Export ALL Products
Average Yields and Prices for 1995· Arpechim, Petromidia and Rafo

		Cost/Price	$
	Tons	$/Ton	Amount
Cost of Imported Crude Oil	**100 0**	**(127 35)**	**(12,735)**
Products Refined and Sold			
LPG/Naphtha	5 3	130 04	693
Petrochemical Naphtha	7 9	130 04	1,019
Unleaded Gasoline 82 RON	3 3	131 46	432
Unleaded Gasoline 90 RON	5 7	139 63	792
Unleaded Gasoline 95 RON	20 2	154 04	3,123
Kerosene	3 6	143 87	520
Diesel	32 8	138 38	4,529
Low Sulfur Fuel Oil	4 2	87 30	357
High Sulfur Fuel Oil	3 0	72 89	222
Fuel Coke	2 2	32 33	44
Needle Coke	0 0	215 69	0
Other	0 5	78 64	40
Fuel + Loss	**11 2**	**0**	**0**
Revenue If All Products are Exported	**100 0**	**117 72**	**11,772**
Gross Margin (Loss)		**(9.62)**	(962)
Variable Costs (excluding fuel + loss)	100 0	(2 60)	(260)
Net Margin (Loss)	**100 0**	**(12 22)**	**(1,222)**

As shown in Figure 2-1, the net refining margins for conversion refineries in the Mediterranean market have been significantly negative for several years We do not foresee any changes in the Mediterranean market which would cause these margins to improve dramatically enough to make export refining profitable

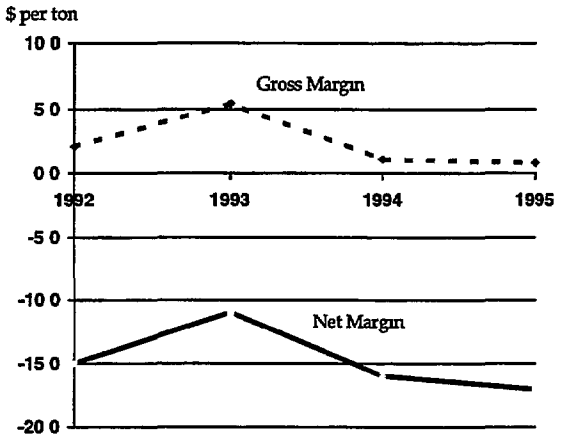

Figure 2-1 Typical Mediterranean Refining Margins

2.3.3 Mismatch Between Demand and Refinery Configuration

Romania's refineries are configured to produce light products while its markets need more heavy products, especially fuel oil The nation also is short of crude oil and relies on imported oil to meet its petroleum needs To obtain imported crude oil and process it into the required refined products, the refineries are being operated to process the maximum amount of crude oil which, after export of light products, will supply all the domestic market's current needs for diesel, distillates, fuel oil, etc Large amounts of crude oil are imported and refined only to export a large quantity of the light products yielded from that refining The net effect of these transactions is that Romania has indirectly acquired fuel oil and distillates As will be shown below, the cost of procuring such products in this manner is far greater than the cost of purchasing them on the open market

Our analysis clearly demonstrates that domestic demand for petroleum products can be most economically met by a combination of (1) refining all domestic crude oil and some imported crude oil and (2) directly importing heavy distillates and fuel oil rather than manufacturing them The gap between Romania's unusually high demand for fuel oil and the Romanian refineries' inherent capabilities to convert fuel oil into light products makes importation of heavy products inevitable Shown in Table 2-2 below are the economics of importing crude oil and processing it to retain the fuel oil

Table 2-2
Case 2 Import 100 Tons of Crude & Keep Fuel Oil Versus Import ONLY Fuel Oil

	Tons	Revenue (Cost) $/Ton	$ Amount
Manufacture Fuel Oil*			
Purchase Crude Oil	100 0	(127 35)	(12,735)
Incur Variable Costs		(2 60)	(260)
Sell All Products Except Fuel Oil	81 6	137 24	11,194
Consume Oil Through Fuel and Loss	11 2		
Cost of Retained Fuel Oil	7 2	(250 28)	(1,801)
	Tons	**$/Ton**	**Amount**
Import Same Amount of Fuel Oil			
Low Sulfur Fuel Oil	4 2	(106 70)	(443)
High Sulfur Fuel Oil	3 0	(93 70)	(285)
Cost of Imported Fuel Oil	**7 2**	**(101 20)**	**(728)**
Excess Cost of Manufacturing Fuel Oil	**7 2**	**149 08**	**1,073**

* Import crude, keep fuel oil and export the rest

Based on the same data used in the previous example, the cost of the crude oil is $127 35 per ton for 100 tons, an aggregate of $12,735 To this is added a variable cost per ton of $2 60 per ton, yielding another $260 in cost From the 100 0 tons of crude oil 81 6 tons are sold at an average price of $137 24 per ton, yielding $11,194 of revenue About 11 2 tons are lost through refinery fuel use and loss, leaving 7 2 tons of fuel oil at a net cost of $1,801 ($12,735 + $260 - $11,194) That same 7 2 tons could be purchased on the open market for $728 Thus to refine 7 2 tons of fuel oil costs $1,801 whereas buying it costs only $728, a difference of $1,073 or $149 08 per ton Romania cannot afford to pay $149 08 per ton extra to make fuel oil instead of purchasing it This $149 08 per ton represents a direct loss to Romania, but is not the only loss There are other costs of running the refineries, and there are negative environmental impacts in processing 100 tons to keep 7 2 tons Clearly this practice should be discontinued

With no possibility of profitable toll processing, and fuel oil more cheaply supplied by imports, the only source of demand for the processing capacity of the Romanian refineries comes from domestic demand for products other than fuel oil This demand amounted to 9 3 million tons in 1995, less than one-third of the 33 million tons of existing capacity Even after robust growth in demand, our analysis shows that, if the most economical approach is followed, just 14 million

tons of crude processing capacity will be needed through 2005 Three large refineries and three small ones can readily meet this refining demand

2 3 4 Optimization of the Five Large Refineries

Should Romania continue to operate all five large refineries, significant gains can be realized through refinery optimization and capital investment We have examined the sector's basic operating practices and facilities constraints, and we have modeled the effects of improving them Our calculations show that removing the impact of all regulations and government controls, investing $264 million and "optimizing" the processing of crude oils while keeping all five large refineries operational, will increase the NPV of future cash flows Rather than a current NPV of negative $2,572 million (which includes a contribution from petrochemical operations) the results would improve to a positive $203 million (refining only, excluding all petrochemicals) This represents a huge improvement with an NPV of $2,775 million This difference reflects the impact of fully abandoning Romania's complex structure of government controls and operating each of the existing refineries in alignment with economic incentives It assumes the elimination of all processing under the barter arrangements and further assumes that staffing levels are reduced as described in the Labor Section It also assumes that unchanging operating parameters are replaced with economically based setpoints and operating practices to improve yields and reduce fuel use and loss Literally hundreds of changes to operating practices would be required to transform Romania's manufacturing sub-sector into a collection of commercially focused enterprises and a set of behaviors that are motivated purely by economic incentives Though the effort will be difficult, the rewards of the transformation clearly justify its undertaking

Experience in other countries has shown that the most efficient method for transforming state-owned companies into economic enterprises is through some form of privatization, but Romania's downstream sector cannot realistically undergo any type of privatization at this time The fundamental problems of massive overcapacity, intrusive government control and excessive employment must be addressed first

2 3.5 Benefits of Decommissionings

Discussed below are the economic benefits and performance improvements attainable through refinery decommissionings and other cost reductions

2 3 5 1 Decommissioning of a Single Large Refinery

Decommissioning one large refinery would dramatically increase plant utilization rates, reduce redundant overhead costs and increase the sector's NPV by $211 million, to $415 million, excluding petrochemicals Our analysis indicates that Petrobrazi is the poorest economic performer among the five large refineries Decommissioning Petrobrazi drops the investment

needs to $215 million at the other refineries and would significantly improve the utilization rates of the remaining four refineries' "core" refining units (i e , those units which drive economic performance) Shown below in Table 2-3 is that even after improvement, however, the utilization rates only reach the lower end of the range considered normal for sustainable operations

Table 2-3
Utilization Rates with a Large Refinery Decommissioning

	Five Large Refineries		Four Large Refineries		Change	
	2000	2005	2000	2005	2000	2005
	%	%	%	%	%	%
Atmospheric Distillation	42	62	60	84	18	22
Catalytic Reforming	45	62	75	83	30	21
Catalytic Cracking	60	83	71	96	11	13
Coking	56	70	67	76	11	6

2 3 5 2 Decommissioning of Two Large Refineries

Decommissioning a second large refinery would further increase the performance of the sector, raising plant utilization rates, reducing redundant overhead costs and increasing the sector's NPV by another $98 million, to $512 million, excluding petrochemicals In this case, because two refineries are closed, the level of critical investments would drop to approximately $170 million Our analysis demonstrates that Petrotel and Petrobrazi represent the two worst economic performers among the five large refineries As shown in table 2-5 decommissioning Petrotel and Petrobrazi would increase the sector's utilization rates of its "core" refining units to economic levels of performance that are considered acceptable for sustained operations

2 3 5 3 Decommissioning of Small Refineries

All five of the small Romanian refineries are economically inferior to the larger refineries We recommend that two of these refineries be decommissioned (Steaua Romana and Vega) and that Darmenesti be integrated into Rafo, an adjacent large refinery, to reduce cost The remaining two refineries, which serve niche markets that are remote from the other large refineries and can economically serve markets in their immediate vicinity, should remain open

Table 2-4
Utilization Rates with Two Large Refineries Decommissioned

	Four Large Refineries		Three Large Refineries		Change	
	2000	2005	2000	2005	2000	2005
	%	%	%	%	%	%
Atmospheric Distillation	60	84	78	86	18	2
Catalytic Reforming	75	83	85	88	10	5
Catalytic Cracking	71	96	82	100	11	4
Coking	67	76	74	70	7	(6)

2 3 5 4 Staffing Reductions

Reducing the staffing levels at the remaining refineries results in additional efficiency gains and increases the sector's annual cash flows by $62 million, which is included in the figures above The staffing levels at all of Romanian plants are over twice as high as equivalent plants in other developing markets and up to eight times higher than state-of-the-art plants If the workforce at the six refineries that remain operational are brought into alignment with customary levels, the sector's workforce would be reduced by 24,800 people to 12,900 This residual staffing level includes 2,500 workers assigned to contract-maintenance firms in an outsourcing arrangement

2 3 6 Direct Crude Oil Purchase by Refineries

There are many barriers preventing refineries from implementing direct commercial arrangements in international markets to optimize their own operations The most obvious barriers are the refineries' lack of access to bank letters-of-credit and hard currency Less obvious barriers include the refinery managements' lack of access to timely market information, limited skills in analyzing markets, and lack of experience in negotiating and executing international transactions In addition, the financial gridlock in settling commercial transactions between government entities has desensitized the refineries to the time value of money, further aggravating the lack of financial accountability

Commercial arrangements with international traders are further impeded by (1) the refineries' inability to control the quantity and quality of incoming crude oil supplies or refined product shipments to and from the refineries, (2) the problems facing nongovernment clients in dealing with the bureaucracy, and (3) the poorly motivated workforce Consequently, with only minor exceptions (e g , limited Hungarian interest in processing at Rafo), virtually no oil is currently being received through *direct* commercial arrangements Also, as previously discussed, the refineries are engaging in uneconomic bartering, a practice we believe destroys value and should be stopped

2 4 HARD CURRENCY IMPACTS

In efforts to minimize the foreign currency drain of the downstream petroleum sector, Romania is employing crude oil procurement methods which are causing economic losses Other government policies are creating a massive increase in net foreign currency outlays In particular, the price subsidy from the producer, Petrom, to the refiners is preventing development of oil production that would have the greatest impact on reducing the hard currency cost of imports Below we summarize the adverse consequences of both of these policies and the benefits of changing them

Romania's demand for domestic petroleum products must be met by

- manufacturing products from domestic crude oil,
- net imports of finished petroleum products and from
- manufacturing products from imported crude oil

In 1995, domestic demand was 14 8 MMT as shown in Table 2-5 Domestic production of crude oil was 6 5 MMT and, after allowing for 11% consumption during the refining process, it contributed 5 8 MMT of refined products to meet demand We estimate that net imports of refined products were 3 2 million tons, leaving 5 8 million tons of domestic product demand (14 8 MMT minus 5 8 MMT minus 3 2 MMT) to be supplied from refining of imported crude oil

To supply this remaining 5 8 MMT from imported crude oil under Romania's current operating practices (barter processing) requires importing and processing 11 3 MMT of crude oil The cost of half this amount (5 65 MMT) is paid for by using foreign currency The other half (5 65 MMT) is paid for by exporting 4 3 MMT of gasoline Because gasoline is more expensive than crude oil, only 0 75 tons of gasoline are needed to pay for 1 0 tons of crude oil, and 4 3 MMT of gasoline are sufficient to fully pay for 5 65 MMT of crude oil When refined, the 11 3 MMT of crude oil produces a total of 10 1 MMT of products (1 2 MMT is consumed in the refining process) Given the barter requirement for 4 3 MMT of gasoline, only 57 percent of these refined products are available for domestic demand, which exactly equals the requirement of 5 8 MMT

Roughly $985 MM of foreign currency was required to support this activity in one year Paying for 50% of the crude imports requires $679 MM (5 65 MMT times $120/ton) Another $306 MM is required to pay for the product imports (3 2 MMT times $96/ton) As demand grows in the future, the net requirement for foreign currency would rise to $1,273 MM per year in 2000 and $1,635 MM per year in 2005 Combining these annual requirements by using a 10%

Table 2-5
Projected Foreign Currency Requirements

Millions of tons per year	Under Current Operating Practices 1995	2000	2005	Under Recommended Rationalization 1995	2000	2005
Total Domestic Demand for Refined Products	14 8	17 2	19 7	14 8	17 2	19 7
Amount Supplied from Domestic Crude Oil (1)	-5 8	-5 8	-5 8	-5 8	-5 8	-5 8
Amount Supplied by New Romanian Crude Oil (2)	-	-	-	-0 9	-3 8	-5 4
Amount that Must Be Supplied from Imports	9 0	11 4	13 9	8 1	7 6	8 5
Amount of Imported Products	-3 2	-3 7	-4 3	-3 2	-3 7	-4 3
Amount that Must Be Supplied from Imported Crude Oil	5 8	7 7	9 7	4 9	3 9	4 3
Amount of Imported Crude Oil (3)	11 3	15 0	19 0	5 5	4 4	4 8
Less Amount Consumed in Refining (11% Fuel & Loss)	-1 2	-1 7	2.1	-0 6	-0 5	-0 5
Products Exported as Partial Barter Payment for Crude Oil (4)	-4 3	-5 7	7 2	0 0	0 0	0 0
Remaining Products Supplied to Domestic Market	5 8	7 7	9 7	4 9	3 9	4.3
Foreign Currency Cost of Imported *Crude Oil*						
Tons of Imports Paid for with Currency (MMT) (5)	5 7	7 5	9 5	5 5	4 4	4 8
Price of Imported Crude Oil ($ per ton)	$ 120	$ 121	$ 126	$ 120	$ 121	$ 126
Cost of Imports ($MM)	$ 679	$ 908	$ 1 198	$ 663	$ 530	$ 603
Foreign Currency Cost of Imported *Products*						
Tons of Imports Paid for with Currency (MMT)	3 2	3 7	4 3	3 2	3 7	4 3
Price of Imports (mostly fuel oil) ($ per ton)	$ 96	$ 98	$ 103	$ 96	$ 98	$ 103
Cost of Imports ($MM)	$ 306	$ 365	$ 437	$ 306	$ 365	$ 437
Total Foreign Currency Cost of Imports ($MM)	$ 985	$ 1 273	$ 1 635	$ 969	$ 895	$ 1 040
Net Present Value of Foreign Currency Costs ($MM) (6)	$ 10 825			$ 8,386	8 386 0	$ 0

Notes
(1) Represents 6 5 MMT/year of domestic crude oil production less 11% fuel and loss yielding 5 8 MMT of products
(2) Based on $269 MM additional production expenditure per year $37 50/ton finding and development costs 12% of proved reserves initial production and 12% production decline per year
(3) Calculated assuming 50% of the cost of imported crude oil is paid for by delivery of gasoline export
(4) Represents 50% of the crude oil import cost divided by the price of gasoline
(5) Represents 50% of Crude Oil Imports under current operating practies and 100% under recommended rationalization
(6) Represents Annual Costs over 20 Years Discounted at 10% Per Annum

discount rate the foreign currency requirement yields a Net Present Value of $10,825 MM for the next 20 years of imports

Under our recommended rationalization approach, however, the overall requirement for foreign currency would be reduced in all periods and by a significant sum in just a few years Two factors drive this change

- Eliminating the need to make product for barter trading significantly reduces the amount of crude oil purchased Unfortunately, 100% of the remaining tons of imported oil must then be paid for using foreign currency The result of this factor by itself is a slight increase in the requirement for hard currency in each period This negative effect is offset first by better economics on the sector through savings of Lei-based costs and second by the other rationalization benefits discussed below

- Implementing the recommended rationalization program improves the financial performance of the sector from a $305 MM loss to a $142 MM average profit, as shown previously This includes the adoption of market pricing, which would free Petrom and Romanian consumers from having to subsidize the refining sector In Petrom's case, this will mean higher cash flows of $269 MM per year, which can be used to significantly reduce foreign currency requirements If Petrom invests this money annually in oil production activities inside (or outside) Romania, and even if Petrom's performance is worse than average (finding and development costs of $5 per barrel or $37 50 per ton, about 25% higher than private-sector companies costs), then this additional investment will result in discovery of 7 2 million tons of new reserves each year Again, using industry averages, this level of new reserves would result in an initial year's oil production of 0 9 million tons of new oil This 0 9 MMT of additional production directly reduces Romania's crude oil import requirement by $108 million (based on a market crude oil price of $120 per ton) Each year Petrom could invest a similar amount, resulting in a cumulative 3 8 MMT per year increase in production by 2000 and 5 4 MMT per year increase in production by 2005 These levels of production take into account an assumed 12 percent per year decline in production for each tranche of investment

Undertaking all the steps of our rationalization strategy would result in a downstream sector which imports significantly less crude oil As shown in Table 2-5, while the net foreign exchange required for the recommended case in 1995 is similar to the amount required in the current practices case ($969 MM versus $985 MM), by 2000 a tremendous benefit can be developed The recommended rationalization approach requires substantially lower annual net foreign currency outlays in 2000 and 2005 as compared to current practices and policies The NPV of the annual foreign currency requirements for our recommended approach, using a 10% discount rate over 20 years, is only $8,386 MM, or $2,439 MM below the levels under current practices and policies

2 5 CRITICAL INVESTMENTS

The following critical investments are required assuming that the recommendation to close two large and two small refineries are implemented

- $11 1 million to enhance feedstock processing capabilities at Arpechim, Petromidia and Petrotel
- $27 1 million for additional hydrotreating capacity at Arpechim
- $24 3 million for additional hydrotreating capacity at Rafo
- $0 8 million for additional hydrotreating capacity at Petromidia
- $11 3 million to expand Petromidia's FCC
- $63 4 million for environmental projects at refinery sites
- $10 5 million to decommission the two large and two small refineries
- Total critical investments are estimated to be $163 million

2 6 KEY FINDINGS AND RECOMMENDATIONS – INDIVIDUAL REFINERIES

In the Romanian downstream petroleum sector, the single most important issue is that the country possesses about twice as much refining capacity as it needs Realistically, there are no possibilities for Romania to economically utilize this surplus capacity It is simply not possible to economically import crude oil and then export refined products into international markets Petroleum product demand within Romania is far too low to absorb the surplus capacity now or in the foreseeable future

The fact that all 10 Romanian refineries continue to operate is itself a massive distortion In a market economy this could not happen because low utilization would force intense competition and drive the weaker performers into bankruptcy In Romania, overcapacity is supported through artificial means Controlled prices are subsidizing the substantial costs of redundant capacity and inefficient operations The subsidies are fully consumed in covering the costs of inefficiency and waste, leaving the refiners unable to afford the investments needed to improve operations

The economic viability of the five large refineries was evaluated using the Process Improvements Modeling System (PIMS) linear programming model, our assessment of internal Romanian demand, and Bonner & Moore's projections of international market prices for crude oil and petroleum products Detailed models covering each manufacturing complex were constructed under several different operating scenarios The economic models included not only the refineries but also the petrochemicals and lubricants activities within the same manufacturing complexes Spreadsheets were built in combination with the PIMS model to generate annual cash flows for the years 1995 through 2005 From these cash flows, the NPV was calculated based on a 10% rate of return over a 20-year period, after 2005, the results for 2005 were held constant for 10 additional years In addition, a foreign exchange NPV was calculated to summarize the amount of foreign currency the downstream sector would require under each scenario These, together with a strategic assessment of the underlying assets, served as the primary factors guiding our optimization and rationalization recommendations for the five large refineries The economic viability of the five small refineries was evaluated by a simpler, qualitative process

To establish an economically viable and operationally sustainable sector, two large and two small refineries should be permanently shut down and decommissioned The cost structures and operating practices of the remaining refineries also must be dramatically improved Our analysis demonstrates that Petrobrazi and Petrotel are the poorest economic performers among the large refineries and Steaua Romana and Vega are the least economic of the small refineries Decommissioning four refineries would increase the utilization rates of the sector's core refining units to economically optimal levels and would produce the highest NPV of future cash flows for the sector

In calculating the annual cash flows for each refinery under the various scenarios considered, we included the fully integrated economic effects of the refining, petrochemical and lubricant

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manufacturing facilities Below, we describe the primary factors which drove the economic results for the refining portion of each plant The unique aspects of the petrochemical and lubricant facilities are dealt with in subsequent sections of this report

2 6.1 Petromidia

Located on the Black Sea coast, Petromidia is farther from domestic oil fields and has more limited access to domestic oil fields than the other refineries Using market of border equivalent pricing, this disadvantage is not economically significant as domestic production covers less than half of the country's requirement for crude oil The rest is imported and during the next 10 years Romania will import between 4 and 13 million tons of foreign crude oil annually Unique among the refineries, Petromidia is ideally suited to refine this imported oil because it is located near Romania's primary oil import terminal and can most economically access the international crude markets

As discussed previously, the margins for toll processing (importing crude oil and exporting all products) are terrible in this region because the Mediterranean market serves as a market of last resort for surplus refined products While Petromidia is best suited among Romania's refineries to serve the international markets, these poor market conditions will make any sustained toll processing extremely unprofitable However, the ongoing transformation of the economies of the former Soviet block may present temporary opportunities for Petromidia to toll process profitably We expect even these opportunities to vanish in only a few years as more rational economic behavior establishes itself in those countries As shown in Table 2-6, below, at Petromidia the costs of purchasing imported crude oil ($122 01 per ton) and incurring the variable costs for processing ($1 90 per ton) are higher than the value of products refined ($120 23 per ton) if all products are exported, resulting in a negative processing margin of $3 68 per ton

Petromidia has logistical advantages for delivering product to the eastern and coastal regions of the country, but these markets are not large enough to consume all of Petromidia's products, and the rest must be sold in the centrally located Muntenia market Petromidia is geographically remote from central markets compared to the Ploiesti refineries, leaving it disadvantaged relative to the other large refineries

Table 2-6
Case 3 Import 100 Tons of Crude and Export ALL Products
Average Yields and Prices for 1995 Petromidia

	Tons	Cost/Price $/Ton	$ Amount
Cost of Crude Oil Feedstock	**100 0**	**(122 01)**	**(12,201)**
Revenues From Products Refined and Sold			
LPG/Naphtha	6 0	132 87	795
Petrochemical Naphtha	3 6	132 87	479
Unleaded Gasoline 82 RON	2 5	132 87	332
Unleaded Gasoline 90 RON	0 0	139 62	0
Unleaded Gasoline 95 RON	31 4	156 87	4,919
Kerosene	10 8	143 87	1,561
Diesel	27 0	142 87	3,862
Low Sulfur Fuel Oil	0 0	90 13	0
High Sulfur Fuel Oil	0 0	72 88	0
Fuel Coke	5 8	10 66	61
Needle Coke	0 0	215 69	0
Other	0 2	77 13	13
Fuel + Loss	**12 7**	**0**	**0**
Revenue From Products	**100 0**	**120 23**	**12,023**
Gross Margin	**100 0**	**(1 78)**	**(178)**
Variable Costs (excluding fuel + loss)	100 0	(1 90)	(190)
Net Margin (Loss)	**100 0**	**(3 68)**	**(368)**

At 3 5 million tons per year of processing capacity, Petromidia is the smallest of the five large Romanian refineries It is, however, very well balanced in that all of its basic distillation capacity is backed by conversion and coking capacity Petromidia's catalytic cracking complex, the single most important refining unit for generating economic value, was recently upgraded with world class technology It produces the nation's highest yield of gasoline (56 weight %) and the nation's second highest level of quality (92 5 RON) In many ways, Petromidia represents a model for the type of value-adding, operationally balanced core refining facilities which are needed at the other refineries Petromidia's advantages due to superior design and technology far outweigh its logistical disadvantages For these reasons, Petromidia performed best in our economic evaluations, and we recommend that it remain operational

To enhance the balance between Petromidia's core refining units and to address tightening sulfur specifications, we recommend the following critical investments totally $31 4 million for Petromidia

$3 7 million	to enhance feedstock processing capabilities
6 8 million	for sulfur plant refurbishments
0 8 million	for revamping the kerosene hydrotreater
11 3 million	to revamp FCC and expand capacity by 30%
8 9 million	for environmental projects
$31 5 Million	Total

Despite its technological and logistical advantages, Petromidia exhibits many of the poor operating and managerial practices which reduce performance in all of the Romanian processing plants Under the centrally planned crude purchase and allocation system, the refinery is constrained from optimizing is feedstock selection and product mix Its staffing is excessive and advanced instrumentation is not used The operating paradigm is passive and risk averse Consequently, the full capabilities of the existing equipment are not being achieved As mentioned, we recommend that Petromidia reduce its staffing levels from 4,754 employees to a total of 2,732 permanent employees plus 238 employees to be included in separate contract maintenance companies

2 6 2 Arpechim

Located 70 kilometers west of Ploiesti, Arpechim is the westernmost large refinery in the country In many ways, Arpechim represents the 'classic' inland refinery, in that it is well suited to receive crude oil and produce products for local market consumption With access to an adequate system of pipelines, Arpechim is provided ready access to both domestically produced and imported crude oils While in the past there has been some interest by international companies in toll processing at Arpechim, their primary goal was to exploit artificial distortions between local-currency costs for transport and manufacturing, and their international market equivalents These, "opportunities" have been discovered and eliminated, making toll processing structurally unattractive at Arpechim over the long term As shown in Table 2-7, the costs of purchasing imported crude oil ($128 24 per ton) and incurring the variable costs for processing at Arpechim ($1 20 per ton) are significantly more than the value of products received ($113 17 per ton) if all products are exported, resulting in a $16 28 per ton negative processing margin

Arpechim has slightly more limited access to the large Muntenia demand center than Petrotel or Petrobrazi However, this logistical disadvantage is small (only 50 kilometers) and results in only very minor transportation disadvantages On the other hand, Arpechim has a logistical advantage for delivering product to Benat and Transylvania via existing product pipelines

Table 2-7
Case 4. Import 100 Tons of Crude and Export ALL Products
1995 Yields and Prices. Arpechim

	Tons	Cost/Price $/Ton	$ Amount
Cost of Crude Oil Feedstock	**100 0**	**(128 24)**	**(12,824)**
Revenues from Products Refined and Sold			
LPG/Naphtha	2 7	128 62	354
Petrochemical Naphtha	15 7	128 62	2,017
Unleaded Gasoline 82 RON	0 0	132 87	0
Unleaded Gasoline 90 RON	17 0	139 62	2,377
Unleaded Gasoline 95 RON	6 4	152 62	970
Kerosene	0 0	143 87	0
Diesel	32 2	133 62	4,301
Low Sulfur Fuel Oil	8 7	85 88	744
High Sulfur Fuel Oil	6 2	72 88	449
Fuel Coke	0 0	10 66	0
Needle Coke	0 0	215 69	0
Other	1 4	72 88	106
Fuel + Loss	**9 8**	**0**	**0**
Revenue From Products	**100 0**	**113 17**	**11,317**
Gross Margin	**100 0**	**(15 08)**	**(1,508)**
Variable Costs (Excluding fuel + loss)	**100 0**	**(1 20)**	**(120)**
Net Margin (Loss)	**100 0**	**(16 28)**	**(1,628)**

At roughly 6 5 million tons per year of processing capacity, Arpechim is one of the largest refineries in Romania. Arpechim has a small design disadvantage because it does not possess a coking plant Our projection of prices indicate that coking margins are attractive in Romania, and the lack of this capability disadvantages Arpechim Arpechim's strength lies in the capabilities of its catalytic cracker Catalytic crackers convert low-value fuel oil into high-value gasoline, and generally add more economic value than any other refining process unit At 4 8 million tons per year of capacity, Arpechim's catalytic cracking complex is the largest in Romania This plant is by far the largest producer of high-octane (93 5 RON) gasoline components in the country and has the second highest gasoline yield (52%) The capabilities of Arpechim's catalytic cracking complex and its relatively strong logistical position combine to far outweigh its lack of coking facilities, and make it one of the best-performing refineries in our economic analysis

To de-bottleneck the capacity of Arpechim's core refining units and to address tightening sulfur specifications, we recommend the following critical investments totally $48 5 million at Arpechim

$3 7 million to enhance feedstock processing capabilities

$3 1 million to revamp existing hydrotreating

$10 million to revamp existing naphtha hydrotreating and de-bottleneck FCC capacity

$14 million for new hydrotreating capacity

$17 9 million for environmental projects

$48 5 Million Total

Like Petromidia, Arpechim suffers from many of the operational inefficiencies common to all Romanian processing plants The refinery is constrained from optimizing its feedstock selection and product mix by central planning system Staffing is excessive, advanced instrumentation is missing and the operating paradigm is passive and risk averse Consequently, the full capabilities of the in-place equipment are not achieved As mentioned previously, we recommend that Arpechim reduce its staffing levels from 8,056 employees to a total of 3,754 employees plus 1,192 employees to be placed in separate contract maintenance companies

2 6 3 Rafo

Rafo is set apart from the other refineries, being located in the northeastern corner of Romania Like Arpechim, Rafo is an inland refinery designed to efficiently import crude oil and serve the Moldavia and Transylvania markets The existing Conpet pipeline and similar pipelines for carrying crude oil from Moldavia oilfields provide Rafo with adequate access to both domestic and imported crude Its only regional competitor is the smaller Darmanesti refinery Like Arpechim and Petromidia, we project negative margins for toll processing at Rafo

At 5 2 million tons per year of processing capacity, Rafo is an average large Romanian refinery Its design and capabilities are similar to those of Petrotel Rafo's core refining facilities are centered around average size and performance catalytic cracking and coking plants To enhance its design strength, we recommend that the nearby Darmanesti refinery be consolidated with Rafo, which will protect Darmanesti's needle coke facilities (the only such facilities in Romania) while trimming Darmanesti's marginal and redundant basic refining capacity The integrated Rafo/Darmanesti plant performed well in our economic evaluations, aided by its logistical advantage in serving the Moldavia and Transylvania markets However, our evaluation methodology did not compare Rafo directly to either Petrotel or Petrobrazi, as RAFO's logistical strengths were considered sufficiently strong to retain it as a future refining center

Rafo also suffers from many of the operational inefficiencies common to all Romanian processing plants, though somewhat less so The refinery is constrained from optimizing its

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feedstock selection and product mix by the Rafirom dominated supply and allocation monopoly Staffing is excessive, advanced instrumentation is missing, and the operating paradigm (setpoints) is passive and risk averse Consequently, the full capabilities of the equipment are not achieved We recommend that Rafo reduce its staffing levels from 3,804 employees to a total of 1,982 employees plus 417 contract maintenance personnel

2 6.4 Petrotel

Located in central Romania, near the Muntenia demand center, Petrotel is configured as yet another inland refinery Capable of receiving domestic oil produced regionally and imported oil through the Conpet pipeline system, Petrotel has adequate access to feedstock supply Like all the other large refineries, there is virtually no possibility of employing Petrotel's capacity for toll processing

Petrotel is ideally suited to serve the large Muntenia demand center, in competition with Petrobrazi and Arpechim With the close proximity of these three large refineries, central Romania is the region where refining overcapacity is greatest In fact, our analysis showed that there is no realistic possibility to keep more than one of these refineries operational given the projected levels of demand in the region

In many ways, Petrotel typifies a large Romanian refinery It possesses average-sized catalytic cracking and coking units, though their performance is lower than that of Arpechim, Petromidia and Rafo Petrotel is a large plant, with many units, some dating back to the inception of oil refining is central Europe While this makes for proud tradition and rich heritage, in the arena of intense economic competition only superior technology and balanced operations will produce bottom-line results Our economic evaluation determined that Petrotel's performance is inferior to that of Petromidia, Arpechim or Rafo In our overall analysis, Petrotel did not have a single compelling flaw that led to our conclusion, but rather its lower performance across virtually all units, and the lack of an offsetting and compelling advantage rendered Petrotel's position relatively weak economically as compared to the others

Unlike the other large refineries, Petrotel has a significant lubricant operation that is potentially capable of profitable operation even if the refinery is closed This lubricant plant processes about 240,000 tons of feedstock per year to produce about 60,000 tons of lube base stock and about 170,000 tons of other lubricant products While it is very small in relation to the Petrotel refinery, this lube plant is an important producer within the lubricant sub-sector, accounting for about 25% of the lube base stock produced in Romania As indicated in the lubricant section of this report, this lube plant is only marginally viable, and operates at break-even on a variable margin basis Because the lube plant is small relative to its associated refinery and only marginally viable, it creates no advantage for the Petrotel refinery Furthermore, the lubricant operation provides no rationale for continued operation of the refinery because it is capable of standalone operation Therefore, these two issues, the operation of the refinery and of the lube plant, should be evaluated independently of one another

2 6 5 Petrobrazi

Like Petrotel, Petrobrazi is located in the intensely competitive central region of the country It has similar access to domestic and international feedstocks, and virtually identical access to domestic markets Once again, losses on toll processing will prevent this capacity from being employed for toll processing

Unlike Petrotel, the performance of Petrobrazi's core refining facilities is below that of the other large refineries Petrobrazi does have a large petrochemical complex However, as explained in the Petrochemical section of this report, those facilities are not economically viable, and should be closed even if the Petrobrazi refinery remains operational despite our recommendation to close it Unfortunately, the combined effects of below-average performance of both the refining and petrochemical facilities makes Petrobrazi the poorest economic performer of the five large Romanian refineries

2 6 6 Small Refineries

We did not directly evaluate any of the five smaller refineries during this study However, an overview of the existing facilities indicates that they lack sufficient scale and use less-advanced technology relative to all of the large refineries For this study, we assumed that most of the small refineries would be decommissioned The exceptions are Darmanesti (mentioned above together with Rafo), Petrolsub and Astra

Petrolsub is remotely located in the far northwest corner of Romania, and is fed solely from a oilfield producing crude oil by in-situ combustion This oilfield and Petrolsub form an integrated unit, as neither is capable of operating independently of the other We have assumed that the combined economics of both plants were positive (although we did not validate this assumption) In addition, we assumed that Astra had marginally profitable operations due to its unique capabilities to manufacture lubricants from the regionally produced naphthenic crude oils Accordingly, we adjusted downward both the domestic demand requirements and the domestic crude oil production projections available to the large refineries for all periods by roughly one million tons to reflect continued minimal operations at Astra and Petrolsub

2.7 KEY FINDINGS AND RECOMMENDATIONS· PETROCHEMICAL SUB-SECTOR

The economic viability of the individual units within the petrochemical sub-sector was evaluated using a series of spreadsheet models together with our projections of internal Romanian demand growth, projected real international market prices for feedstocks and flat international market prices for petrochemical products The overall petrochemical sub-sector was divided into groups of associated assets Each group was analyzed as a whole, then, individual plants within the group were analyzed Plants which could not demonstrate the ability to generate a positive net

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margin were selected for rationalization The viability of the overall group was then assessed based on the strength of the remaining economically viable plants

The petrochemical sub-sector is comprised of both (1) viable operations which are capable of sustained value creation and (2) non-viable operations, which destroy value and drain sub-sector resources Specific petrochemical units, which produce the polyolefins (polyethylene and polypropylene) and certain other products (including acrylonitrile and DMT for textile fibers) form a sustainable manufacturing base to serve growing downstream industries Other petrochemical units are redundant or non-viable and should be shut down to eliminate wasteful operations and improve economic results of the sub-sector

Through government regulation, petrochemical price controls distort markets and create non-commercial price levels, improper incentives, and market shortages We recommend that all price controls be eliminated to foster national economic development and improve decision making in this sub-sector Current petrochemical management practices are not adequate to meet the competitive challenges confronting the sub-sector We recommend improvements in management practices to strengthen manufacturing operations, petrochemical capacity planning, and marketing effectiveness

2 7 1 Summary of Economic Viability

We assessed petrochemical operations at Arpechim, Petrotel, Petrobrazi, and Petromidia Table 2-8 summarizes the results of our assessment The figure indicates units that are operating and those that are idle The shading of a particular unit indicates that the unit is non-viable

2 7 2 Methodology of Evaluation

Overall petrochemical results were included in the economic valuations of the manufacturing complexes To assess parts of the petrochemical plants, we developed a simple model to assess economic viability of individual petrochemical units First, the values of all products were determined based on market pricing Next, all costs were evaluated, including raw material costs (at market prices), utility costs, and fixed costs Once costs and product values had been determined, the ratio of costs to product value was computed A result **smaller** than 1 0 indicates that product value exceeds costs and that the unit is creating value, a result **greater** than one indicates that costs exceed product value and that the unit is destroying value Where a high cost-to-value ratio clearly indicates value destruction and the unit cannot be made viable by reasonable means, we recommend closure of the unit

Table 2-8
Viability Summary For Petrochemical Units

Non-Viable

		Plant Sites				
	Units	Arpechim	Petrobrazi	Petrotel	Petromidia	Comments
Units Supplied by the Arpechim Steam Cracker	LDPE	Operating			Idle	• Arpechim s LDPE HDPE ethylene oxide and ethylene glycol units are viable The units at Petromidia are based on similar technology and scale The idle Petromidia units will be needed within five years due to increasing demand for these ethylene derivatives
	HDPE	Operating			Idle	
	Ethylene Oxide	Operating			Idle	
	Ethylene Glycols	Operating			Idle	
	EPDM Rubber	Operating		Operating		• The EPDM unit is not viable (small scale non-competitive technology)
	Acrylonitrile I	Operating		Operating		• The two acrylonitrile units at Arpechim are viable
	Acrylonitrile II	Operating	Operating	Operating		• The ethyl benzene unit at Arpechim is not viable Styrene which is produced from ethyl benzene and the other styrenics units (polystyrene and ABS) are not viable at either petrochemical site
	Ethyl Benzene	Operating				
	Styrene	Idle				
	Polystyrene	Idle				• The ethoxylate units at Petrobrazi are not viable (ethoxylated phenols demulsifiers ethanolamines choline chloride polyethylene glycols and antifreeze)
	ABS	Idle				
	Ethoxylate Units					
Polypropylene Units	Polypropylene			Operating	Operating	• Current polyethylene demand is low compared to total capacity The consolidation of Petrotel s production into Petromidia, the superior unit, will make the Petromidia unit viable
Aromatic Derivative Units	Phthalic Anhydride		Operating			• The anhydride units at Petrobrazi are viable based on cost-to-value ratios However the shutdown of the Petrobrazi refinery will disrupt feedstock supply Accordingly these units should be shut down
	Maleic Anhydride		Operating			
	Phenol/Acetone	Operating	Operating		Idle	• The phenol/acetone unit is not viable based on available cost information
	DMT		Operating			• Total DMT capacity is low relative to demand. The Arpechim unit has adequate capacity to produce current and near-term DMT requirements
Carbon Black	Carbon Black	Operating				• The carbon black unit at Arpechim is viable based on current carbon black demand.

In the case of idle units we inferred viability by a comparison with operating units of comparable technology and scale For example, Petrotel's styrenics units (styrene, polystyrene, and ABS) are in service but are non-viable because of obsolete process technology The corresponding units at Arpechim are currently idle Because the Arpechim styrenics units are based on similar technology, we have inferred that the Arpechim units are also non-viable

For redundant units, we tested the impact of closing one plant and sending all demand through to the other plant In two specific cases, polypropylene and DMT, analysis of individual plant units suggested they were uneconomic, stemming from low utilization rates because total demand was divided between redundant plants The sharing of production at very low volumes led to very high per-unit costs In these cases, in our rationalization recommendations we consolidated the total volume into the plant with the lower per-unit costs The more favorably positioned unit was deemed viable, the other unit is non-viable On this basis the Petromidia polypropylene unit is economically viable while the Petrotel unit is not, and the Arpechim DMT unit is economically viable while the Petrobrazi unit is not

At Petrobrazi, the small operating units producing phthalic anhydride and maleic anhydride were found to be viable based on their cost-to-value ratios, but their positive contribution cannot offset the other deficiencies of Petrobrazi The decision to shut down the Petrobrazi refinery will disrupt the supply of feedstock to these units These operations cannot be sustained in the absence of reliable and cost-effective feedstock sources Therefore we recommend closure of these units

To assess viability, units have been organized by derivative families to facilitate comparisons among and between similar units Summarized below and presented in more detail in the remainder of this section, are viability results of the petrochemical unit groups

- *Ethylene and propylene derivative units that are supplied by the Arpechim steam cracker*

  This steam cracker, the only current source of ethylene in Romania, also produces polypropylene, chiefly for acrylonitrile manufacture This group includes low density polyethylene (LDPE) high density polyethylene (HDPE), ethylene oxide, ethylene glycol, ethyl benzene, EPDM, acrylonitrile, and carbon black units at Arpechim, styrene, polystyrene, and ABS units at Petrotel, and ethylene glycol, ethanolamine and other ethoxylate units at Petrobrazi

- *Polypropylene units*

  This group includes the polypropylene units at Petromidia and Petrotel Propylene is currently supplied to each of these units from the related refinery's catalytic cracking unit

- *Aromatic Derivative Units at Arpechim*

  This group includes the DMT, phthalic anhydride, maleic anhydride and phenol/acetone units at Petrobrazi and the DMT unit at Arpechim These derivatives are produced from aromatic precursors including benzene, ortho-xylene, and para-xylene

In addition, a single unit produces carbon black at Arpechim

2 7 3 Units Supplied by the Arpechim Steam Cracker

All of Arpechim's ethylene and propylene derivative units are in operation, other than the styrene and styrene polymers units Arpechim supplies ethyl benzene as a feedstock for the production of styrene at Petrotel and ethylene oxide for the production of ethoxylates at Petrobrazi Viability calculations were not possible for the ethoxylate units at Petrobrazi because the Petrobrazi staff declined to supply the needed data Therefore, the assessment of the viability of Petrobrazi's ethoxylate operations was based on reported financial results for Petrobrazi petrochemicals

Figure 2-2 below presents cost-to-value ratios for Arpechim's operating units producing ethylene and propylene derivatives The Arpechim cost-to-value ratios indicate that two units, producing ethyl benzene and EPDM rubber are much greater than 1 0 and therefore non-viable High per unit costs of ethyl benzene are explained largely by operating scale This unit operates at about 30% of capacity, and its capacity is small compared to world-scale units Low operating rate also penalizes the economic performance of the EPDM unit This unit currently operates at about 20% of its operating capacity, and its capacity is less than one-tenth the capacity of competitive world-scale units We recommend closure of these two units

The cost-to-value ratios for the Petrotel styrenics units, including styrene, polystyrene and acrylonitrile-butadiene-styrene polymer units, are shown in Figure 2-3 below These units are non-viable The high cost of polystyrene and ABS production is the consequence of non-competitive process technology There is no cost-effective revamp option Operating rates are low compared to globally competitive operations for all of these units

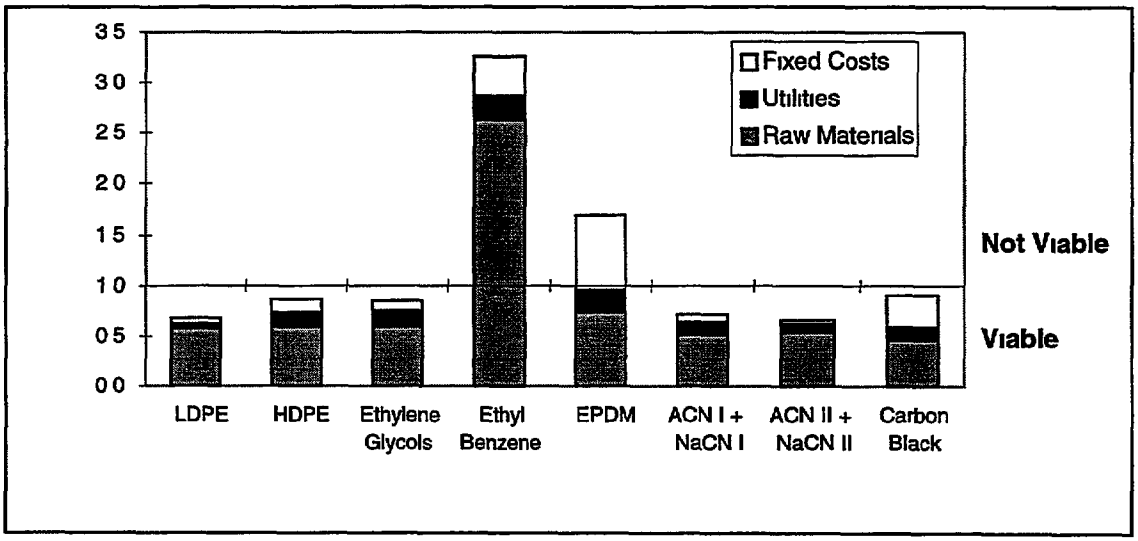

Figure 2-2
Arpechim Viability Assessment (1995)

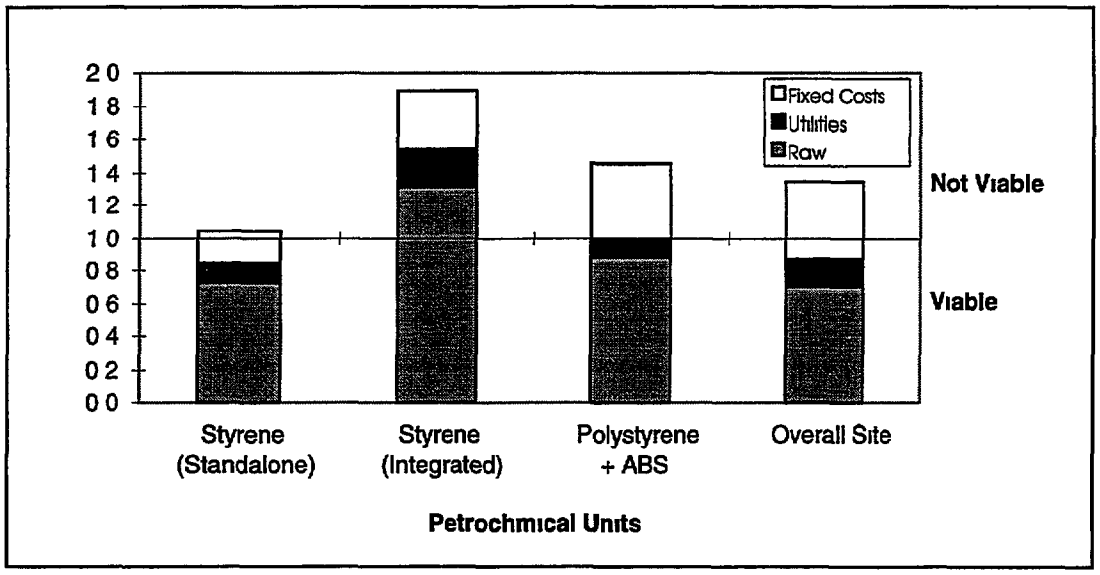

Figure 2-3
Petrotel Styrenics Viability Assessment (1995)

Although consolidation is possible, the transfer of Petrotel's styrene, polystyrene and ABS production to the idle units at Arpechim would produce little benefit because the Arpechim units, which are based on similar process technology, would yield similar results We recommend shutdown and decommissioning of the styrene, polystyrene and ABS units at both Petrotel and Arpechim

Because the information provided for the Petrobrazi ethoxylate units was inadequate, we relied solely on the 1994 income statement for Petrobrazi petrochemicals Combined results for ethoxylated products indicated a loss equivalent to roughly 47% of the value of products sold in 1994 All of these Petrobrazi units are small in scale, and production rates are low relative to capacity We recommend shutdown of the Petrobrazi units that produce ethoxylates, including ethoxylated phenols, ethanolamines, demulsifiers, choline chloride, ethylene glycols, and antifreeze

2 7 4 Polypropylene Units at Petrotel and Petromidia

Polypropylene is now produced at both Petromidia and Petrotel The two production units have the same capacity, and employ the same technology Current polypropylene demand is estimated at 30,000 tons per year, roughly 50 percent of the capacity of a single unit and 25 percent of the capacity of the two units taken together Because overall capacity is high compared to current demand, our polypropylene viability assessment compared the cost performance of a single unit with the cost performance of two units which share the production volume

Shown in Figure 2-4 below are cost-to-cost value ratios for four operating scenarios In the first scenario current polypropylene volume continues to be divided equally between Petromidia and Petrotel, and each operates at 25% of capacity In the second scenario, current volume is consolidated into a single unit at 50% of capacity In the third scenario, a single unit operates at 75% of capacity, producing a volume of polypropylene consistent with projected demand in 2005 In the fourth scenario, full capacity utilization is assumed, indicating a best case scenario under the existing cost structure

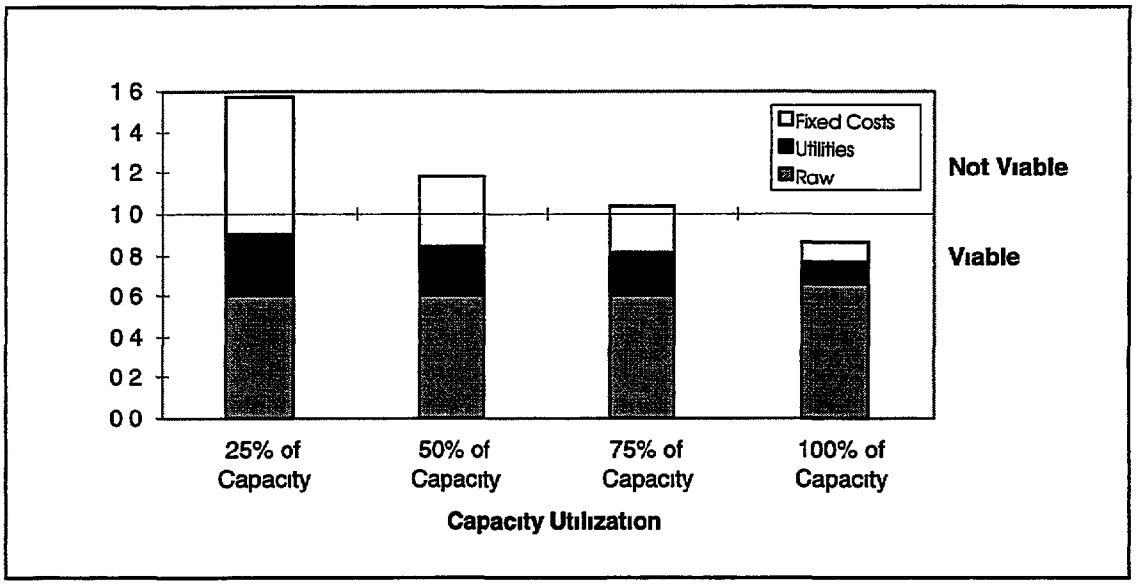

Figure 2-4
Polypropylene Viability Assessment (1995)

These results clearly demonstrate that the polypropylene operation should be limited to a single unit in the Petromidia refinery While the installed process technology is similar at the two sites, the Petromidia unit has compelling advantages Petromidia's product handling and shipping capabilities are vastly superior to Petrotel's, Petromidia has superior marketing capability, and the Petromidia staff has substantially greater operating experience Given Petromidia's decisive advantage, the Petrotel polypropylene unit is non-viable and should be shut down

2 7 5 Aromatics Derivatives

Aromatics derivative units at Petrobrazi produce dimethyl terephthalate (DMT), phthalic anhydride, acetone and phenol Maleic anhydride is produced by two units from different precursors, benzene and normal butane DMT is also currently produced at Arpechim as well as Petrobrazi Shown in Figure 2-5 below is our viability assessment for the five units at Petrobrazi and the DMT unit at Arpechim

Note that the cost-to-value ratio for the phenol/acetone unit is high, indicating value destruction In fact, conclusions regarding this unit are difficult because the cost data provided by the Petrobrazi staff were incomplete and because production outages (caused by refinery FCC outages and other feedstock interruptions) severely penalized the phenol/acetone unit's cost performance during the data collection period

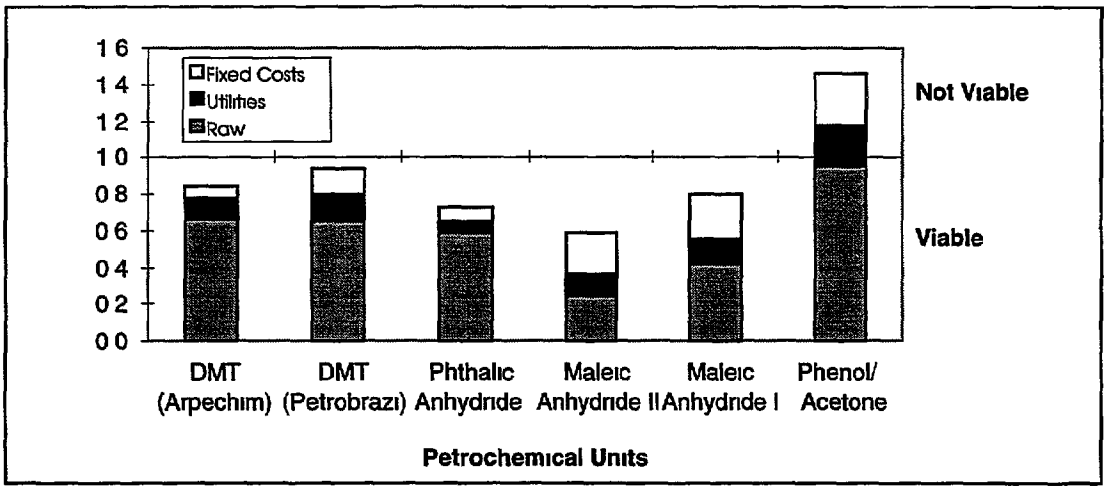

Figure 2-5
Aromatics Derivatives Viability Assessment (1995)

The cost-to-value ratio is slightly lower for the Arpechim DMT unit than for the Petrobrazi DMT unit The current operating rates for both units are low relative to capacity The Arpechim unit, the larger of the two, has adequate capacity to satisfy current DMT demand, while the Petrobrazi unit does not Therefore, current DMT demand can be met through consolidated operation only if the Petrobrazi unit is shut down and its production volume is transferred to Arpechim We recommend shutdown and decommissioning of the Petrobrazi DMT unit

A decision to close the Petrobrazi refinery will, of course, disrupt current feedstock supplies to all of the petrochemical units producing aromatic derivatives at Petrobrazi While the anhydride units appear to be economically viable, these operations cannot be sustained in the absence of reliable and cost-effective feedstock sources Closure of the Petrobrazi units producing phthalic anhydride, maleic anhydride, and phenol/acetone is recommended

2 7.6 Capacity Planning

Management practices must be strengthened to improve manufacturing operations, capacity planning, and marketing effectiveness This strengthening will enable the petrochemical units to reduce costs Aggregate cost data for these petrochemical operations indicate that raw material and utilities now account for 80% - 85% of total manufacturing costs Each 1% reduction in both

raw material usage and utility consumption for all petrochemical units would result in a cost savings of more than $2 million per year

In addition, the enterprises must maintain high capacity utilization rates to enhance cost-effectiveness By maintaining high utilization rates, the enterprises can realize the lowest per-unit costs of production In order to maintain high utilization rates, managers should delay the startup of large capacity increments until actual demand has already exceeded production The alternative is to build capacity before demand materializes This latter strategy often results in surplus capacity and higher per unit costs of production, accordingly, we recommend against this latter approach

Improved skills and capabilities are also needed in petrochemical marketing The enterprises must improve their understanding of domestic customers in order to identify the most attractive customer groups and to develop effective strategies for serving them Marketing staffs must be developed to carefully analyze domestic downstream industries to determine which customer segments offer growing and profitable sales

In the case of export sales, current reliance on chemical traders poses a barrier to meaningful understanding of customer requirements and attractiveness Direct contacts with export consumers are the only means by which the companies can establish firm export relationships and gain useful customer insights As in the case of domestic sales, these insights are essential to accurately identify attractive customers and to develop effective strategies to serve them

2 7.7 Petrochemical Pricing

The direct regulation of prices for primary petrochemicals and the indirect regulation of prices for other petrochemical products have impeded the commercial transformation of Romanian petrochemicals Government regulation of pricing has resulted in non-commercial price levels, improper incentives among petrochemical producers and consumers, and market shortages

Prices of primary petrochemicals, including propylene, benzene, toluene, para-xylene and ortho-xylene, are directly regulated All of these primary petrochemicals, with the exception of toluene, serve as petrochemical feedstocks Benzene and toluene are also sold to downstream chemical customers, both domestic and export Prices for these materials are established by the Government

An analysis of price levels has revealed serious misalignment between regulated prices and market prices for these directly regulated materials Para-xylene provides one example Demand for para-xylene rose substantially in 1995 due to increased demand for its derivatives, used chiefly in textile fibers production The regulated price of para-xylene, which is far below the market price, contributed to a shortage of this material by diminishing the incentive to produce it The lifting of price controls is recommended because price controls cause artificial shortages and other forms of market failure, and are inherently inefficient

Individual customers have joined together to form associations within downstream chemical industries for price negotiation purposes Negotiations culminate in contractual price agreements The government of Romania exerts undue influence over petrochemical prices through the sponsorship of these negotiations All recent negotiations have been prompted by requests from customer associations, and government-sponsored price negotiations have resulted in prices below market levels

We recommend termination of both direct and indirect regulation of petrochemical pricing The elimination of price controls in both forms will lead to direct pricing negotiations between producers and customers, and to the market pricing of petrochemicals We further recommend that laws or regulations be implemented to prevent collective bargaining negotiations by either customer groups or selling groups

2 8 KEY FINDINGS AND RECOMMENDATIONS – LUBRICANTS SUB-SECTOR

The economic viability of the lubricant sub-sector focused on the capabilities of the current participants to compete for market share We quickly determined that the lubricant manufacturing sites are small-scale, low-technology facilities that operate at a loss The real issues in assessing the viability of these sites are whether and where they can effectively compete against higher-quality, higher-cost imported lubricants and whether they can do so profitably Our assessments were based upon analysis of the plants, the markets and the capabilities in processing, distribution and marketing

Romanian lubricants manufacturing facilities have serious deficiencies in process technology, which lead to poor quality which is made worse through contamination during distribution Because of these quality problems, almost all private vehicle owners, who represent the most attractive customer segment, have abandoned Romanian lubricants in favor of imports Only industrial (including military) and commercial automotive customers continue to buy lubricants in high volumes from Romanian processors These customers are often more sensitive to price than quality and are often state-owned companies Ultimately these markets will also become competitive and before then Romanian lubricants producers must quickly strengthen their commercial skills and improve product quality using all means available in efforts to satisfy the increasingly stringent demands of these customers, or risk the loss of these segments as well

Lubricants manufacturing operations lose money at market prices due to obsolete process technology Of the six manufacturing sites, three, including Arpechim, Vega and Steaua Romana, cannot become economically viable due to process technology which cannot be upgraded We recommend that these sites be closed Drastic improvement in cost performance will be essential for the remaining sites to achieve economic viability on a medium-term basis

2 8 1 Breakdown of the Market and Current Approach

Romanian lubricant manufacturers have historically sold products to three major customer groups (including the military) industrial consumers, commercial automotive consumers and private vehicle owners Industrial consumers and commercial automotive consumers are often state-owned companies with strong traditional linkages to state-owned lubricant manufacturers As state-owned firms, those customers are more prone to procure products at the lowest price, even if quality is low Private vehicle owners, on the other hand, are individual citizens who are strongly motivated to purchase high-quality lubricants in order to protect private automobiles, which represent substantial personal investments Table 2-9 below presents these segments of the lubricant market, indicating representative customers and factors which influence their lubricant purchasing decisions

Table 2-9
Romanian Lubricant Consumers

	Industrial	Commercial Automotive	Private
Representative Customers	Fabricated metal manufacturers Chemicals and allied products Transportation equipment Mining operators Pulp and paper	Agriculture Construction firms Fleet operators Mining operators	Private vehicle owners
Products and Applications	Industrial engine oils (railroad, marine, gas) General industrial oils (hydraulic, gear) Metalworking fluids	Commercial engine oils Gear, hydraulic and transmission oils Greases	Passenger car motor oils Brake and transmission fluids
Purchasing Decision Maker	State sector procurement agent representing a state firm		Individual customer
Buyer Values	Price, and Lei denomination of purchases State sector supply relationships Product availability and reliability of deliveries Product quality		Product quality Product availability Price

As shown above, buyer values which influence private vehicle owners are radically different from those which influence purchasing agents within state-sector industrial and commercial automotive companies Private vehicle owners place substantially higher value on quality than state-sector purchasers and are less sensitive to price Foreign manufacturers recognize that buyers who place high value on good products represent a market that can yield attractive profits

Because private owners are willing to pay more for high-quality products, they represent the most attractive customer segment to private-sector sellers, and the new foreign firms have organized themselves to penetrate this market Private customers perceive that Romanian lubricants are of very poor quality compared to imported lubricants For these reasons, despite the huge price disparity, imports now account for a very high proportion of sales to private vehicle owners

Romanian lubricant manufacturers do not possess the capabilities necessary to recapture the private vehicle segment Romanian lubricants cannot match the quality of imports due to severe limitations in manufacturing processes and in distribution processes (blending and handling) Moreover, PECO lacks crucial skills in merchandising and channel management Packaging, for example, is poorly designed and badly imaged Products are inappropriately merchandised, with limited shelf space Thus, while private lubricant customers represent the most attractive commercial opportunity, Romanian lubricant processors and distributors cannot recapture this opportunity Importers simply have a competitive lead that Romanian counterparts are highly unlikely to narrow

At present, Romanian lubricant manufacturers are capable of satisfying the limited quality and service requirements of domestic industrial and commercial automotive consumers However, these customers will also develop a preference for higher quality and better service, causing them to question traditional sourcing relationships As these customers seek to make their own businesses competitive, they will use better lubricants matched to their needs

Romanian suppliers must dramatically improve their product quality and service capabilities in the following areas or lose the remaining markets to competitors

- Technical sales support and quality Sophisticated commercial consumers purchase lubricants through fact-based rather than perception-based decision processes, matching lubricants with application requirements through technical specifications and systematic performance testing programs Product quality is not a competitive edge, it is a precondition to serving these customers
- Extensive and varied lubricant product line Commercial applications are highly varied The supplier must serve these diverse needs through an extensive product line
- Rapid and reliable delivery capability Commercial consumers expect rapid delivery of orders of multiple lubricant types Strong inventory planning skills and an effective delivery network are required

2 8 2 Lubricants Manufacturing

Our review of the revenues and operating costs of the two largest producers, Astra and Petrotel, revealed that their lubricant operations contribute very small positive margins when taking only variable costs into account When fixed costs are deducted, both of these lubricants businesses

are unprofitable These two producers must immediately undertake dramatic reductions in costs to have a chance of becoming viable

Both Astra and Petrotel utilize the dewaxing capability of Lubrifin, a privately owned manufacturer, to produce finished lubricants The combined operations of the three plants provide a manufacturing base that may prove to be viable for the supply of lubricants to industrial and commercial automotive consumers in Romania However, future viability will depend upon rapid development of the necessary commercial capabilities and upon marked improvement in cost performance

The remaining lubricant manufacturing sites are non-viable, and we recommend closure of the following

- Vega's small-scale and high-cost operation is severely non-competitive Vega's high costs are due chiefly to excessive yield losses from its chemical refining process
- Arpechim's lubricant operation is simply too small to be commercially viable and is not technologically self-sufficient Large capital investments would be necessary to develop Arpechim's hydrocracking capability for lubricant production These large supporting investments are unreasonable given Romania's competitive position in lubricants
- Steaua Romana's lubricant operation was not assessed Note, however, that shutdown of the Steaua Romana refinery has been recommended in the refining section of this report It is improbable that the lubricant operation could be economically sustained following the refinery shutdown

Table 2-10 below summarizes the economic viability of these producers and presents current volumes of manufactured lubricants Volumes produced by the non-viable sites are insignificant in relation to overall production and in relation to Romanian lubricant demand

Table 2-10
Lubricant Manufacturing Viability

Manufacturing Site	Viable/Non-Viable	1994 Volume (Tons)
Astra, Ploiesti	Potentially Viable	126,000
Petrotel, Ploiesti	Potentially Viable	61,000
Lubrifin, Brasov (private company)	Not Applicable	27,000
Arpechim, Ploiesti	Non-Viable	9,000
Vega, Ploiesti	Non-Viable	6,000
Steaua Romana, Ploiesti	Non-Viable	4,000

2.9 CONCLUSION

A summary of the key findings and recommendations is listed below

- Price distortions aid the refineries but cause larger damage to other, key sectors of the economy
- Trading refined products for imported crude to keep surplus capacity in use generates huge losses
- Optimization of the refineries requires decommissionings, operational charges and staff reductions The optimal configuration is three large refineries operating at high capacities with total fuel oil demand met through imports
- Refineries need to purchase crude directly from supplies and sell directly to users to optimize their slates and operate on a commercial basis
- Petrochemicals are fundamentally viable, but need restructuring and selective decommissioning
- Lubricant manufacturing needs to be downscaled and focused on a few key strengths
- Rationalization of the sector can reduce hard currency requirements by $300 million per year by 2000, with larger reductions in the following years
- The sector requires critical investments of $162 million to achieve viability and permit privatization

Section 3

Distribution and Marketing

This section presents the limitations of the current distribution and marketing companies and recommends corrective action

3.1 CURRENT SYSTEM CONFIGURATION AND LIMITATIONS

The state-owned distribution and marketing companies operate within a system that is impacted by cross-subsidies and widespread inefficiencies These problems restrict their ability to invest in competitive people, equipment and facilities Investment programs by foreign firms and other private investors are too small to date to have any system-wide impact Price controls, high transportation costs, nontariff barriers, and the lack of supply chain infrastructure discourage investment The public now pays subsidies through high prices for poor quality products and service, oil producers subsidize refiners, and the government is deprived tax revenues

The controlled refinery-gate prices and transport tariffs, combined with other noneconomic barriers, depress the economic performance of the retail sector operated by PECO, and restrict the development and operation of the private sector Rigid flat-rate transport pricing creates marketplace distortions that, if unchanged, will ultimately lead to bankruptcy of PECO and PetroTrans These distortions open up artificially induced niche opportunities for independent retailers and those willing and able to bypass the official systems These distortions create real profits for independent retailers by creating losses for PECO and PetroTrans In only a few years PECO has lost 50% of the retail market to small independents with more entrepreneurial management and a customer-oriented approach PECO is at a disadvantage caused by government interference and control of the sector If both are not changed soon PECO will lose nearly all of its markets to independents and sink into bankruptcy This will imperil PetroTrans as well

Other legal and regulatory factors impair foreign investment Tax regulations make is near impossible for foreign companies to own land, inhibiting their control and adversely affecting the security of their investments Local bureaucratic licensing procedures, site approvals and permits require unnecessary steps that consume time and waste money Local politicians, some of whom require the payment of bribes, control access to prime property locations Uneven application of other laws often has resulted in bribes of law enforcers by independent retailers

Transportation and storage infrastructure is lacking in the proper operational, business and environmental controls needed for commercial operation Storage facilities, while numerous, are not strategically located and are inadequate for a multi-supplier market Retail facilities critically need to be upgraded, replaced and expanded overall Modern technologies are needed to improve business decisions, protect the environment, and conduct operations safely Taken together, the lack of investment in a growing marketplace constrains consumer access and imposes unduly high prices on the economy

Operating and commercial practices are inadequate Product losses are relatively high Poor product quality exists due to contamination and poor blending and handling practices Product

quality control and measurement practices are not standardized, regulated or policed Terminal and retail site operating hours are limited to daytime hours, resulting in low asset productivity and a correspondingly low productivity in the delivery and consumer sectors Throughout distribution and marketing, product stockouts are a common occurrence Product shortages in the whole market are routine Customers pay a high price in real and economic terms for this inefficiency

3 1 1 Sub-Sector Assets

Romania's distribution and marketing operations consist of (1) a refined products transportation and distribution system of pipelines, railcars and trucks, 154 related bulk storage terminals, and many small depots, and (2) a marketing network of approximately 1,100 retail outlets (including 500 owned by PECO)

Facilities operated by the state-owned enterprises are in generally poor condition For example 60% of the pipelines are more than 40 years old and require significant ongoing maintenance, tanks at storage terminals and depots are old and pollute the environment, and retail sites are dark, dirty, poorly designed and economically obsolete In most cases these facilities are underutilized The lack of wholesale intermediaries results in inefficient and unsafe product transportation and storage by retail operators

3 1 2 PetroTrans

Virtually all long-haul bulk transportation is controlled by the state-owned company, PetroTrans, which transports approximately 65% of products via railcar and 35% via pipelines With no competition in long-haul bulk transportation, PetroTrans uses cost plus tariff rates which are fixed on a zone-by-zone basis, regardless of the transport method Only modest rate differences apply from zone to zone with a total rate difference of less than 20% from the nearest to the farthest point from the refineries This practice leads to uniform availability and price across all of Romania – but it fails to reflect true economics Customers which are easiest to serve are overcharged while those most difficult to serve obtain a subsidy

PetroTrans is not just a shipper of products owned by others, it is a merchant transporter that takes title to products and is therefore the customer of the refineries and the reseller to distributors PetroTrans bundles the products together with transportation and sells them on a delivered basis to PECO and others The result is a high cost that is not adapted to meet competitive conditions

Independent retailers have a choice in procuring motor fuels They can buy directly from refiners and transport products using private-sector trucks, or they can purchase from PetroTrans on a delivered basis Because independents pay promptly, the refiners often sell products to them at cheaper prices than PetroTrans pays In addition, when their retail sites are close to the refineries, independents can haul product at lower costs using private trucks and avoid the high-cost zone-based tariffs that PetroTrans charges PECO, on the other hand, is compelled to buy

products from PetroTrans and therefore pays the higher prices for refined products and the higher tariffs for transportation in the markets nearest to the refineries Accordingly, the independent retailers make money in these good markets while PECO does not, giving PECO's competitors the ability to invest in more modern facilities and serve customers better

For these reasons and others, the independent retailers have captured over half of the total retail market from PECO in just a few years and now dominate the high volume markets PECO's captive relationship to PetroTrans is compounding this problem creating the deterioration in economic performance As PetroTrans loses the cheaper short-haul market to independent truckers its fixed costs must be borne by an ever-shrinking volume This raises costs ever higher Higher per-liter costs lead to still more volume loss to PECO and PetroTrans, continuing the spiral of destruction This is now harming PECO, and eventually will seriously harm PetroTrans as well, as the circle of dislocation around the refineries gets even wider, moving more of the market to independents at an escalating pace

3.1.3 PECO

Commercial and retail distribution through bulk terminals and depots is organized under PECO This is done through 41 different County PECO state-owned organizations The County PECOs operate all 154 bulk terminals and smaller depots used to distribute refined products They are required to purchase refined products from PetroTrans on a fully delivered basis Products are sold by PECO to end users Some customers are served directly from bulk terminals and depots and others through retail sites The County PECOs operate some 500 retail service stations while the private sector operates about 600 sites, most of which are former PECO sites transferred to the operator

PECO lacks certain characteristics that are necessary for its longer-term survival From an operating standpoint, PECO is not responsive to basic customer needs At retail sites, pump placement is inconvenient to customers, and operating hours are limited and inconvenient Merchandising of non-fuel products is de-emphasized Similar problems exist in serving commercial and industrial customers from distribution terminals and depots

3.2 DISTORTIONS IN THE VALUE CHAIN

Figures 3-1, 3-2 and 3-3 show the value chain (before consumer taxes) for gasoline in Romania, and compare it to the same value chain in a market economy, the United States The USA example provides ultimate retail prices that are nearly the same as those in Romania This comparison is similar to most market economies, including those in most of the European Union The value chain approach recognizes that each link in the chain of converting crude oil into gasoline and delivering it to consumers adds value to the process The comparison of these links in Romania to the comparable U S links graphically show the distortions caused by price controls and the subsequent destruction of value

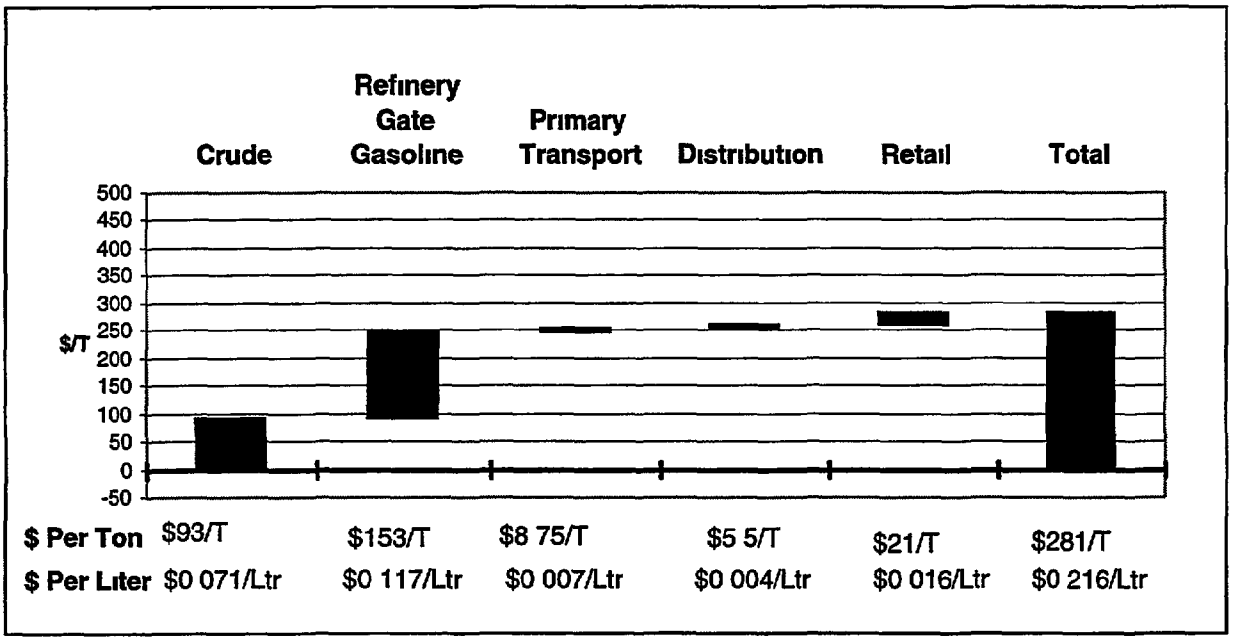

Figure 3-1 Gasoline Value Chain for Romania

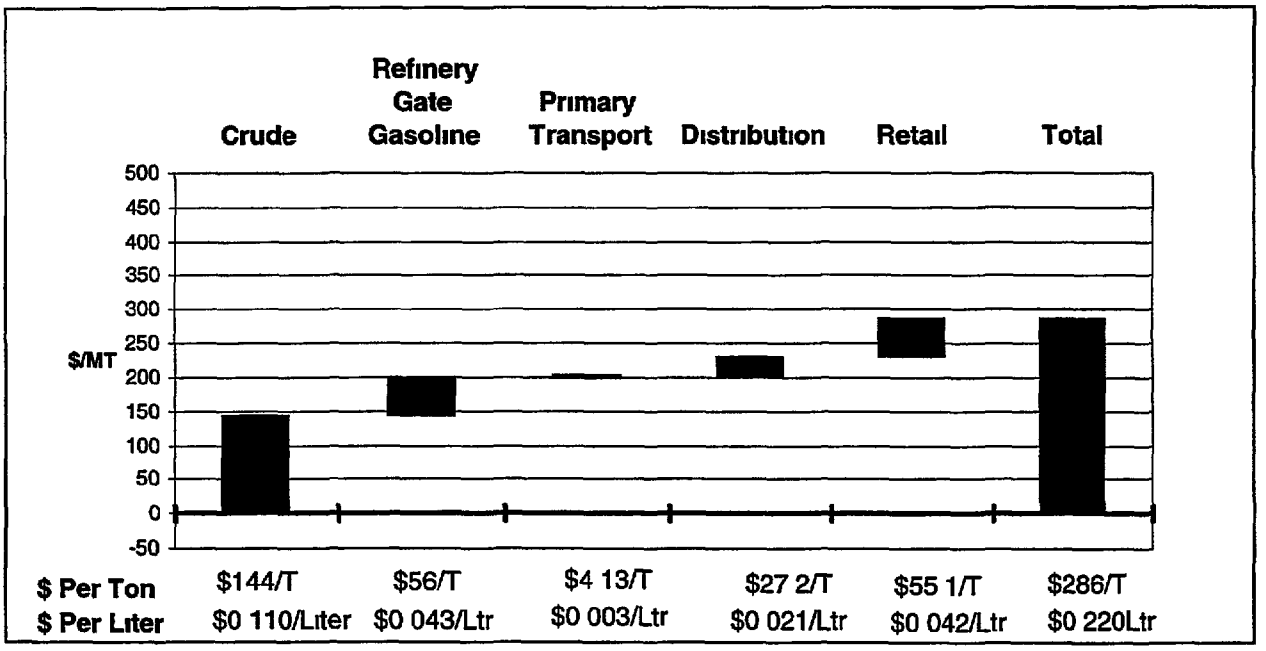

Figure 3-2 Gasoline Value Chain for USA

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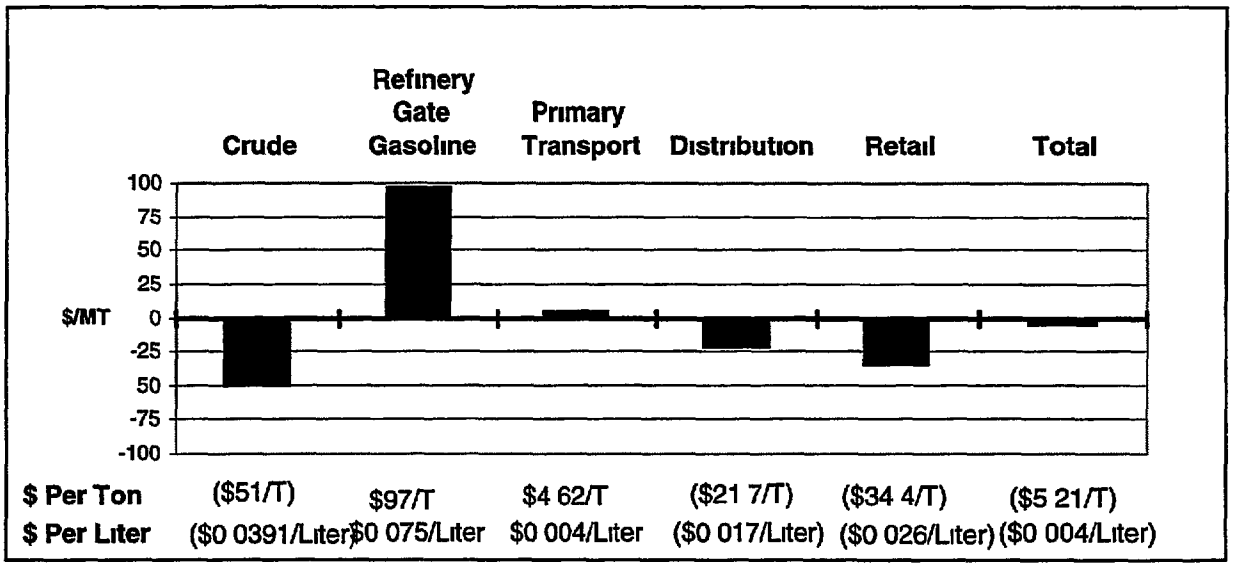

Figure 3-3 Value Chain Differences Between Romania Versus the USA

As these charts show, Romania's **refiners** receive almost three times the refining margin as their USA counterparts, the **transporter** (PetroTrans) receives 112% more, the **oil producer** (Petrom) receives 35% less, the **distributor** (PECO) receives 80% less and the (5) **retailer** (also PECO) receives 62% less Under this system

- Petrom is deprived of the capital that it needs to discover and produce badly needed oil so that the growth of high-cost imports can be reduced and the balance of payments can be improved,
- the refining sector is overpaid to support capacity levels that greatly exceed the needs of the nation,
- an inefficient transport system is preserved and,
- state-owned distributors and retailers are deprived of desperately needed capital to restore their systems

Figure 3-3 clearly shows that Romanian government policies divert a disproportionate share of the total value of the end product to the refineries and primary transportation at the expense of oil producers, distributors and retailers and sacrifice taxes The government policies that subsidize refiners at the expense of others also result in the government losing a considerable source of tax revenues, especially if final prices include taxes at the higher levels found in most European countries Such tax revenues are often used to fund highway, roads and mass transit construction and maintenance and to meet other government priorities

The margin distortions in the distribution and retailing are depriving Romania of foreign investment that could be used to restore the sector to health and develop the retail sub-sector For example, the number of retail stations found in a market economy to serve equivalent consumer needs would total between 2,500 and 5,000 sites as compared to 1,100 in Romania today This represents an enormous potential source of jobs It is possible to employ more Romanians in an expanded retail sector, at higher pay, than the total number of people now employed in the entire refining sub-sector This forms a compelling argument to eliminate price controls, rationalize capacity and employment, and increase private-sector participation

Section 4

Labor Force Reduction and Redeployment

The downstream sector labor force of approximately 57,700 managerial, technical and operations employees is divided between the petroleum manufacturing sub-sector, which accounts for 37,700 employees, and the distribution and marketing sub-sector, which accounts for 20,000 employees The petroleum manufacturing sub-sector workforce far exceeds the staffing level required to effectively operate the refining, petrochemical and lubricant manufacturing facilities This workforce must be sharply reduced to decrease the level of fixed costs While overstaffing is also apparent in the distribution and marketing sub-sector, the problem is not as acute and the anticipated growth of the retail sector will result in expanded labor requirements

Workforce reduction in the petroleum manufacturing sub-sector should be accomplished primarily through the closure of the four least efficient refineries, the outsourcing of major maintenance functions to new private-sector service companies, and further workforce reductions at the complexes that remain in service We estimate that these steps will result in the dislocation of approximately 27,300 employees Labor redeployment costs will include severance payments, unemployment compensation, retraining costs, extended benefits, relocation costs, and start-up costs to provide working capital for the new private-sector maintenance firms Critical investments of about $166 million over a three-year period will be required to fund these redeployment programs Resulting savings through reduced wage costs of about $76 million per year, or $228 million over the three-year expenditure period, will more than offset the cost of the redeployment assistance program

4 1 REFINERY LABOR REDUCTION

The recommended staff reductions will reduce the manufacturing workforce by two-thirds, from 37,700 employees to approximately 10,400 employees plus additional 2,500 employees at contract maintenance firms While this staffing reduction is large as a proportion of current staffing, benchmarking against manufacturing operations of comparable size and complexity indicates that the residual staffing level will still be high by international standards Thus, the reduced staffing level should be fully adequate for effective operation of the rationalized refining sector in Romania, and further reductions are probably feasible in the long run

Figure 4-1 below presents the refinery labor reduction steps, indicating the number of workers displaced by each step

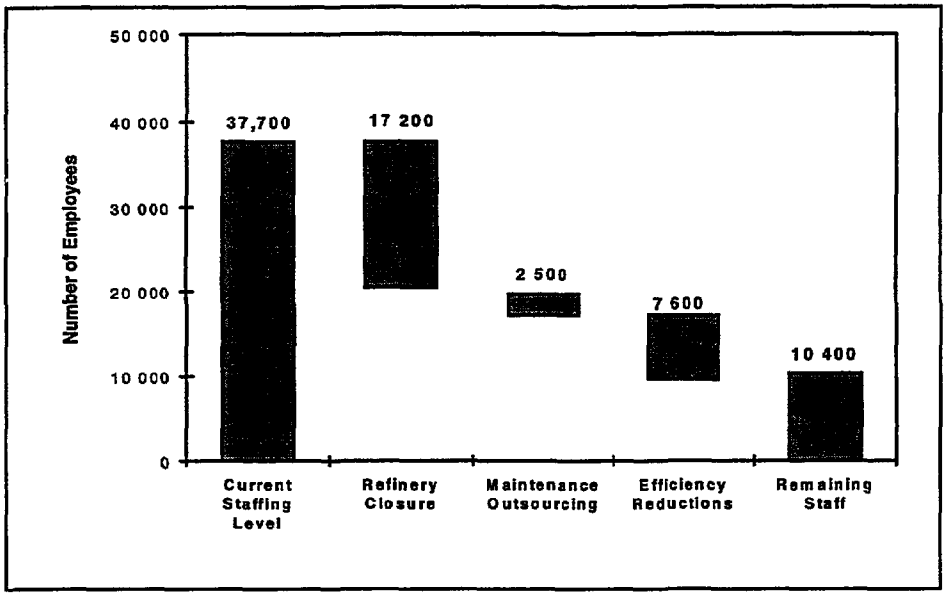

Figure 4-1 Manufacturing Labor Reduction

Labor savings are estimated at $76 million per year once the reduction steps are complete, based on wage and benefit costs of $3,076 per employee

The total staff reduction of 27,300 results from three major destaffing steps

- The closure and decommissioning of two large refineries, for example Petrobrazi and Petrotel, and two small refineries would account for 17,200 employees
- The further reduction of refinery staffs accounts for 7,600 employees This decrease in staffing is based on a 40% reduction in the staff level after maintenance outsourcing

Outsourcing of central maintenance work accounts for 2,500 maintenance employees who are moved to other companies but are considered displaced for severance compensation purposes This reduction level assumes that 200 permanent maintenance workers remain at each operating refinery Note that the 2,500 employees become employees of the new private-sector contract maintenance firms Accordingly, the costs of contract maintenance will continue to be borne by the manufacturing complexes through contractual payments This labor reduction program will require an implementation period of about 18 months

Table 4-1 shows a workforce table setting forth the displacements occasioned by efficiency gains, transfers into separate contract-maintenance firms and refinery shutdowns, the case for illustrative purposes assumes the shutdown of Petrobrazi and Petrotel At the bottom of Table 4-1 is the labor impact of all five large refineries continuing to operate

Table 4-1
Manufacturing Labor Reduction – By Facility

Refinery	Current Staff	Labor Displacement Steps: Refinery Closure	Efficiency Reductions	Total Displaced	Maintenance Outsourced	Total Remaining on Site Payrolls	Annual Savings ($000)
Petrobrazi	7 800	7 800		7 800			23 993
Petrotel	6 490	6 490		6,490			19 963
Petromidia	4 754		1,783	1,783	238	2 732	5 485
Arpechim	8,056		3,111	3,111	1,192	3,754	9,569
Rafo	3 804		1 405	1 405	417	1,982	4 320
Subtotal	30,904	14 290	6,299	20,589	1 847	8,468	63,331
Astra	2,587		918	918	461	1,208	2,824
Petroslub	486		194	194		292	598
Dharmanesti	836		216	216	192	428	664
Steaua ROM	948	948		948			2,916
Vega	1 977	1 977		1,977			6 081
Subtotal	6 834	2,925	1 328	4 253	653	1 928	13 083
Total	**37,738**	**17,215**	**7,627**	**24,842**	**2,500**	**10,396**	**76,413**
Adjustments if Petrobrazi and Petrotel Operate							
Petrobrazi		(7 800)	3,800	(4,000)	400	3,600	12,304
Petrotel		(6,490)	3 197	(3,293)	400	2 893	10 129
Revised Total		2,925	14,624	17,549	3 300	16 889	53 980

4 2 REDEPLOYMENT OF EXCESS LABOR

Reduction of the refinery workforce will result in a large number of displaced workers These workers can be classified in four groups and estimated as follows

- **Group 1** These workers, accounting for 7% of the total, leave the refinery workforce through normal attrition or early retirement during the 18-month implementation period
- **Group 2** Members of this group, comprising 30% of the total, find new employment and are reabsorbed into the economy of Romania The new private-sector maintenance company will absorb a portion of these workers
- **Group 3** Members of the largest group of displaced workers, accounting for 53%, find alternate employment after a period of three years, following extensive retraining and other social assistance

- **Group 4** We estimate that approximately 10% of the workforce will be unable to find alternate work and will remain unemployed

Only a relatively small number of employees will leave the workforce by normal attrition and by early retirement Analysis of the current worker age distribution and turnover rate indicates that voluntary attrition will account for only about 500 workers, or about 2% of the total number displaced About 1,400 workers are expected to accept early retirement under a program offering special incentives to workers over 55 years of age Thus, Group I accounts for only 1,900 workers, about 7% of the displaced workforce

Group 2 is comprised of workers who find alternate employment within the 18-month period required to implement the staffing reduction program About 4,100 workers are expected to find employment in other sectors of the economy It is assumed that the new companies formed to offer outsourced maintenance services will absorb 2,500 workers In addition, 1,500 workers need to be retained to carry out decommissioning and environmental remediation activities at the refineries that are to be closed The two large refineries, will each require 500 workers, the two small refineries, will each require 250 These staffs will be reduced gradually over a two-year period as this work is completed, and we assume that these workers will find alternate employment without retraining assistance

The workers of Groups 3 and 4 will become structurally unemployed upon termination of employment at the refinery sites For these workers, extended benefits and social protection are necessary Workers within Group 3 are those capable of taking advantage of the retraining opportunities to find new jobs outside of the refining sector Extensive retraining will be required to successfully redeploy workers in Group 3 because these workers have narrow industrial skills and little or no alternate work experience Also, they will face strong competition for industrial employment because a number of other heavy industries in Romania must reduce their workforce also

Many of the workers in Group 3 will have to relocate from Ploiesti to other population centers As Romania's economy transforms, the service sector is expected to grow and will account for a growing proportion of employment Net job growth will probably occur most rapidly in trading, business and tourist centers including Brasov, Bucharest, Constanta, and Timisoara While the dispersal of employment outside of the existing population centers should be a long-term goal of national economic development, many displaced refinery workers will be forced to seek work in these cities Mobility assistance will be essential for the structurally unemployed, and this assistance should include housing assistance, resettlement allowances and full transfer of social assistance benefits to new employment locations

It is commonly assumed that the agricultural sector will absorb a significant proportion of excess industrial workers However, employment levels in Romanian agriculture are already excessive Also, current agricultural operations involve minimal mechanization Increased mechanization is

expected to reduce agricultural labor requirements Therefore, workers displaced from heavy industries are unlikely to find employment in agriculture

Group 4 includes workers who will prove incapable of effective participation in retraining and relocation programs This group includes approximately one-half of the workers who are above 40 years of age and who have received no education beyond high school These workers have severely limited skills, and many will be incapable of successful relocation We anticipate that most of these workers will remain unemployed for an extended period, and it is possible that many of them will remain unemployed permanently They may find marginal employment in low-skill service jobs or drop out of the workforce altogether

4.3 CRITICAL INVESTMENTS FOR A SOCIAL SAFETY NET

The elimination of excess refinery labor will lead to a significant and permanent reduction in refining labor costs These savings will be offset in the first three years by critical investments that are necessary for successful labor redeployment These costs include severance payments, unemployment compensation, retraining expenditures and other special requirements such as relocation assistance and funding to support the start-up of the new private-sector maintenance firm Table 4-2 presents an estimate of critical investments required during a period of three years after the termination of feedstock supply to the designated refineries

Table 4-2
Labor Redeployment and Costs

	Number of Workers	Percent of Total	Severance Payments ($ 000)	Unemployment Compensation ($ 000)	Retraining Costs ($ 000)	Special Costs ($ 000)	Total Costs ($ 000)
Group 1	1 900		2 900	2 400			5 300
Group 2	8 100	3(	12 500	10 300		6 000	28 800
Group 3	14 608	5	22,500	25 000	44 900	22,500	114 900
Group 4	2 734	1(	4 200	4 700		8 400	17,300
Total	27 342	100%	42,100	42 400	44 900	36 900	166 300

The table indicates total critical investments of approximately $166 million for labor redeployment Because reduction of refinery labor decreases fixed costs by about $76 million per year, total net savings of about $62 million are expected to be realized during the three-year redeployment period

In planning the refinery closures, least-cost sequencing should be evaluated, and several factors should be taken into account including major maintenance "turnarounds" that will necessitate temporary shutdowns of the six refineries that will remain in operation, cost-effective supply of replacement products to markets served by the refineries to be closed, and least-cost supply of crude oil to all refineries during the shutdown transition period leading to plant decommissioning This study did not cover the planning of the refinery shutdown sequence, nor

the sequencing of employment termination and staff redeployment Both of these steps must be planned in detail

Section 5

Environmental Remediation

The environmental assessment covered the impacts of rationalization to the Romanian downstream petroleum sector The assessment covered the refining, petrochemical and lubricant operations at 10 manufacturing sites, the oil terminal at Constanta, and the landfills containing oil sludge in Ploiesti and Cimpina Pipelines carrying crude oil and products, product distribution terminals, and individual retail stations were not assessed

5 1 SUMMARY OF ENVIRONMENTAL ASSESSMENT AND CRITICAL INVESTMENTS

Romanian refining, petrochemical and lubricant operations have caused severe environmental damage due to pollution sources including air emissions, wastewater and solid wastes Dramatic reductions in pollution levels from these three sources are necessary to protect the public and to comply with European Union (EU) environmental standards In addition, cleanup of accumulated wastes is necessary to reduce public exposure risks Significant remediation efforts to remove accumulated wastes must include waste remediation at refineries that are to be decommissioned, treatment of oily sludge now stored in public landfills, and cleanup of groundwater contaminated by hydrocarbons

Shown in Table 5-1 below are the environmental critical investments required at the manufacturing complexes, the Constanta oil terminal, and the public landfills that contain oily sludge The table presents environmental investments under three scenarios Vega and Steaua Romana are assumed shut down under all scenarios Therefore, no investments have been listed for the abatement of continuing pollution from these two refineries, and their decommissioning costs are included in the environmental investments required under all scenarios Under the first scenario, eight refineries operate, including both Petrobrazi and Petrotel Under the second scenario, seven refineries operate, and Petrobrazi is shut down Under the third scenario, both Petrobrazi and Petrotel are shut down

Table 5-1
Environmental Critical Investments
$ Millions

	Refineries That Operate in All Cases								Small Refineries That Shut Down in *All* Cases				
	Large Refineries			Small Refineries			Other Large Refineries				Non-Refining Sites		
Description	Arpechim	Petromidia	Rafo	Darmanesti	Astra	Petrolsub	Petrobrazi	Petrotel	Vega	S Romana	Oil Terminal	Landfills	Total
Continuing pollution sources.													
Air emission abatement	14 4	13 1	16 3	2.5	2.5	0 8	26 3	13.7			11 5		101 0
Wastewater reduction	2.0	1 1	1 9	0 7	0 6	0 5	2.3	2.5			0 6		12.1
Solid waste reduction	1 5	1.5	1.5	0.2	1 5	0 9	0 8	0.8			0 3		9 0
Subtotal	17.9	15 6	19 7	3 4	4 6	2.2	29.4	16.9			12.4		122.1
Refinery decommissioning							3.5	3.5	1.8	1.8			10.5
Landfill remediation													7.0
Environmental Investment													
Eight refineries operate	17.9	15.6	19 7	3.4	4 6	2.2	29.4	16.9	1.8	1.8	12.4	7 0	132.6
Seven refineries operate	17.9	15 6	19 7	3.4	4 6	2.2	3.5	16.9	1.8	1.8	12.4	7.0	106 7
Six refineries operate	17.9	15.6	19 7	3 4	4 6	2.2	3.5	3.5	1.8	1.8	12.4	7.0	93.3

The cost of remediating groundwater contamination cannot be estimated based on available information A separate environmental impact assessment is necessary to identify remediation methods and to estimate the associated costs

5.2 AIR EMISSIONS, WASTEWATER AND SOLID WASTES

Table 5-2 below summarizes abatement recommendations to reduce air emissions, wastewater and solid wastes to target levels These recommendations affect refinery sites, hydrocarbon storage facilities and the storage facilities at the Constanta oil terminal The abatement steps encompass new environmental technology, instrumentation to monitor effluent streams, and improved practices and maintenance

Air emissions include the categories of sulfur dioxide, hydrocarbon emissions and uncontrolled emissions from fired process heaters As indicated in the manufacturing section of this report, the upgrading of refinery sulfur treatment is necessary to reduce the sulfur content of refined fuels Improved desulfurization is necessary to reduce refinery sulfur dioxide emissions as well Hydrocarbon emissions, chiefly from storage tanks and transfer facilities, must also be reduced by improved tank roof seals and by other modifications The abatement measures outlined below are necessary to reduce hydrocarbon losses to less than 0 01 percent by weight of liquid product throughput which is the EU target for hydrocarbon losses from storage and transfer facilities Other air emissions from fired heaters must be reduced by air preheaters, waste heat recovery investments and other steps to improve combustion efficiency

Table 5-2
Major Pollution Sources and Abatement Recommendations

Pollution Sources	Recommended Abatement Steps
Air Emissions	
Sulfur dioxide	Upgrade sulfur recovery units
	Treat sour water stripper overhead vapor streams for sulfur removal
Hydrocarbon emissions	Modify storage tanks to reduce losses
	Install vapor collection and recovery systems for light product loading
	Upgrade fuel gas recovery compressors
	Install oil separator covers to reduce hydrocarbon emissions
Other air emissions	Improve combustion efficiencies of large process heaters
	Install air emission monitoring instrumentation
Wastewater	

85

Table 5-2 (Cont'd)

High wastewater flow	Install water meters for major refining units
	Reduce cooling water and condensate system losses
	Improve delayed coker cutting water clarification to permit water reuse
High BOD, suspended solids and phenol levels	Install modification to improve air/water mixing and reduce energy usage
	Improve oil/water separators and air flotation units
	Improve wastewater clarifiers
Solid Wastes	Replace inorganic wastewater chemicals with organic polyelectrolytes
	Provide new dewatering facilities for biological sludge and oily sludge

Refinery wastewater flow rates, now estimated at 4 20 cubic meters per ton of processed crude, must be reduced to 2 0 cubic meters per ton or lower during the refinery rationalization period In order to reduce refinery wastewater flow rates, cooling water losses and steam condensate losses must be reduced In addition, improved instrumentation is necessary to provide operating personnel the means to monitor process water usage Table 5-2 also indicates improvements that are necessary to reduce wastewater pollutant levels, notably suspended solids, phenol content and hydrocarbon content, measured as biological oxygen demand (BOD)

The use of inorganic water treatment chemicals at high levels and the inadequate dewatering of biological and oily sludges lead to excessive solid waste generation Conversion from inorganic treatment chemicals to polyelectrolytes and the installation of improved sludge dewatering facilities are recommended to reduce solid waste levels

5 3 REFINERY DECOMMISSIONING AND WASTE REMEDIATION

Refining rationalization recommendations call for the shutdown of two large and two small refineries Shutdown, decommissioning and cleanup activities will involve these steps

- work off existing inventories, both in-process and product inventories
- drain and clean process equipment and remove sludges and other accumulated wastes
- remove refinery equipment for sale and scrap salvage
- complete other cleanup and closure activities, including the filing of underground pipes and vessels with concrete or drilling mud

A two-year period is anticipated for these activities following the termination of crude supply to the designated refineries

The environmental decommissioning costs are estimated at $7 0 million for the two large sites and $3 5 million for the two small sites, or a total of $10 5 million, net of equipment sale proceeds and scrap salvage These costs are based on the assumption that a staff of 1,500 personnel, 500 for each large refinery and 250 for each small refinery, will begin decommissioning activities when feedstock supplies are terminated Gradual destaffing over a two-year period is anticipated

5.4 OIL SLUDGE REMEDIATION

Large accumulations of oily sludge have occurred at landfills in Cimpina from the sludge generation at the Steaua Romana refinery and at landfills in Ploiesti from the sludge generation at Petrobrazi, Petrotel, Astra and Vega Many landfill sites pose a serious risk to the public due to inadequate site security and potential oil leakage Many older landfills, constructed prior to 1990, are not properly constructed to prevent groundwater contamination

Landfill remediation must include the on-site dewatering of oily sludge to recover oil and other contaminants and to reduce sludge volume, followed by the transport of the dewatered sludge to secure landfills for safe impoundment A cleanup cost of $3 million is estimated for landfills in Cimpina, and a cleanup cost of $4 million is estimated for landfills in Ploiesti

5.5 GROUNDWATER CONTAMINATION

Extensive additional efforts are required to adequately assess the contamination of groundwater caused by hydrocarbons leaking from refineries, pipelines and storage terminals Groundwater contamination by leaking hydrocarbons appears to be most serious in Ploiesti Air emission reduction, wastewater and solid waste reduction, refinery decommissioning, and landfill sludge remediation can be managed by the actions and investments outlined above

A thorough Environmental Impact Assessment is required, including geological assessments, estimates of hydrocarbon contamination levels and identification of appropriate remediation methods Since groundwater contamination has affected property owned by public-sector companies, private corporations and individuals, a legal framework must be established to govern the process of land remediation Next, facilities must be installed for hydrocarbon recovery, and the treatment and recovery process must continue until groundwater aquifers have been restored This effort will involve substantial costs and will require effective collaboration among government, industry and private owners

Section 6

Summary of Critical Investments and Rationalization Strategy Action Steps

This section summarizes the critical investments necessary to upgrade the downstream sector to economic self-sufficiency and to permit privatization to proceed An important corollary benefit of these investments is an upgrading of quality standards and environmental emissions to levels acceptable for EU membership

Also detailed below is a summary of the action steps necessary to properly carry out the recommendations contained in the previous sections

6.1 CRITICAL INVESTMENTS

Two types of critical investments are necessary to improve the downstream sector, performance improvement expenditures and environmental expenditures Performance-improvement expenditures represent the installation of equipment and process controls to improve the economic performance of existing facilities and investments to debottleneck processes They also include the costs of decommissioning plants that are to be closed and the costs of rationalizing the workforce at both closing and continuing plants Performance improvement expenditures lead directly to the enhancement of economic results Environmental expenditures represent the costs to clean up the environment by reducing ongoing pollution and by cleanup of past pollution This includes expenditures to improve processes and to add equipment that will eliminate or reduce pollution from ongoing emissions and waste streams Environmental outlays also include costs to clean up certain landfills

In some cases, a single expenditure serves both to improve operational performance and to reduce environmental contamination In these cases the expenditure is classified into the category which best reflects its most important contribution Two examples illustrate this point Installation of sulfur recovery units removes a contaminant (sulfur) from the environment and also allows the refineries to produce reduced-sulfur fuels which are more valuable in the marketplace, serving two purposes at the same time Installation of equipment and processes for vapor recovery and prevention of evaporation both reduces air pollution and retains valuable hydrocarbons that otherwise would vent into the atmosphere

Table 6-1 shows critical investments for each manufacturing complex, Oil Terminal and landfills Note that for Petrobrazi and Petrotel we have included costs assuming shutdown and decommissioning, and, alternatively, assuming that these plants continue to operate Only one of these scenarios will apply either (1) decommissioning will occur at these or other comparable sites and costs thereof will apply together with all labor redeployment costs, or (2) the plants would continue to operate and decommissioning and refinery shutdown labor costs would not be incurred The eight-refinery scenario assumes that all large refineries remain open, the seven-refinery scenario assumes Petrobrazi is shut down and the six-refinery scenario assumes both

Petrobrazi and Petrotel shut down Vega and Steaua Romana are assumed shut down in all scenarios

Table 6-1
Critical Investment Summary
($ Millions)

	Refineries That Operate in All Cases						Other Large Refineries		Small Refineries That Shut Down in *All* Cases		Non-Refining Sites		
	Large Refineries			Small Refineries									
Description	Arpechim	Petromidia	Rafo	Darmanesti	Astra	Petrolsub	Petrobrazi	Petrotel	Vega	S Romana	Oil Terminal	Landfills	Total
Refinery Performance													
Process Improvements													
Crude units	3 7	3 7	3 7				3 7	3.7					18.5
FCC expansion		11.3											11.3
HDT expansion	27 1	0 8	24 3				20 4	27 8					100 4
Subtotal	30 8	15.8	28 0				24.1	31.5					130.2
Decommissioning							3.5	3.5	1.8	1 8			10.5
Labor redeployment													
Efficiency reductions	26.2	12.3	11 1	2.5	8 4	1.2	25.5	21 9					109 1
Refinery shutdown							21.9	17 6	12.0	5 8			57.3
Subtotal	26.2	12.3	11 1	2.5	8 4	1.2	47.4	39.5	12.0	5.8			166.4
Environmental													
Sulfur plants	6 8	6 8	8 0				16.2	6.3					44.0
Air emission abatement	7 6	6 3	8 3	2.5	2.5	0 8	10 1	7 4			11 5		57.0
Wastewater reduction	2.0	1 1	1 9	0 7	0 6	0 5	2.3	2.5			0 6		12.1
Solid waste reduction	1.5	1.5	1 5	0.2	1.5	0 9	0.8	0 8			0 3		9 0
Landfill remediation												7 0	7.0
Subtotal	17.9	15 6	19 7	3 4	4 6	2.2	29.4	16.9			12.4	7.0	129 0
Grand Total													
If the plant operate	74.9	43.7	58.8	5.9	13.0	3.4	79.0	70.3	n/a	n/a	12.4	7 0	368.4
If the plant shuts down	n/a	n/a	n/a	n/a	n/a	n/a	50.9	43.0	13.8	7.5	n/a	n/a	115.2
Investment Scenarios·													
Eight refineries operate	74.9	43 7	58.8	5.9	13 0	3.4	79 0	70.3	13.8	7.5	12.4	7 0	389.7
Seven refineries operate	74.9	43.7	58.8	5.9	13.0	3.4	50 9	70.3	13 8	7.5	12.4	7.0	361.6
Six refineries operate	74.9	43.7	58.8	5 9	13.0	3.4	50.9	43.0	13.8	7.5	12.4	7.0	334.3

6.2 SECTOR RATIONALIZATION STRATEGY AND ACTION STEPS

Shown below is a summary of the action steps required to implement the downstream petroleum sector rationalization strategy, and the costs of implementation

Implementation Steps

1 **Price Decontrol** Decontrol all pricing of crude oil, refined products, petrochemicals and lubricants over a relatively brief period

2 **Liberalize Import** Liberalize restrictions on imports of refined products

3 **Workforce Reduction** Implement the workforce reduction program at all manufacturing complexes through early retirements and termination programs and outsourcing of maintenance functions Reduce the impacts on displaced workers through severance payments, jobs training and relocation assistance Perform a similar analysis in the distribution and marketing sub-sector and implement those programs as well

4 **Holding Company** Establish a special-purpose, limited life holding company for the rationalization of the 10 manufacturing complexes and enforce implementation of the rationalization steps described herein, including the workforce reductions described below

5 **Refinery Closures** Permanently close and decommission two large and two small refineries and merge Darmanesti into Rafo

6 **Petrochemicals Shutdowns** Permanently close all petrochemicals units at Petrobrazi and Petrotel and selected units at Arpechim

7 **Lubricants Consolidation** Permanently close and decommission all lubricants manufacturing at Arpechim, Steaua Romana and Vega Consolidate all lubricants production, cut costs and improve operating and management practices at Astra and Petrotel If, after those measures have been implemented, the lubricants business at those sites is still not profitable, close those as well

8 **PECO and PetroTrans** Eliminate PECO's requirement to purchase only through PetroTrans and permit it to source directly from refiners Convert PetroTrans from a "merchant" transporter to a service-based transporter only PetroTrans' pipelines should be made into common carriers with rate-based tariffs based upon distance and other criteria Railcar and truck transport should be deregulated as to price and service

9 **Environmental Restoration and Remediation** Implement the environmental program to reduce further pollution of air and land and to begin the cleanup of past environmental contamination

10 **Regulatory Oversight** Establish a regulatory function to establish and police quality measurement and environmental standards

11 **Privatization** Begin a privatization plan focused on bringing in well capitalized strategic investors Package key retail sites with associated refinery assets for sale

Program Costs

The total cost of this rationalization, remediation and privatization program is approximately $334 million Cost estimates are shown in Table 6-2

Table 6-2
Total Rationalization Program Costs
1995 US Dollars

Item	Cost
Process improvements at refineries that remain in operation	$74 6 million
Environmental investments for the abatement of pollution from continuing operations	$75 7 million
Environmental remediation of public landfills and cleanup and closure of decommissioned refinery sites	$17 5 million
Programs to retrain and redeploy refinery workers following refinery closures	$166 4 million
TOTAL	**$334 2 million**

Expenditures for refinery process improvements and decommissioning will occur over a period of approximately two years, expenditures to support labor redeployment and remediate public landfill, will take three years to implement