IMPACT OF ETHANOL USE ON U.S. REFINED OIL MARKETS

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Executive Summary

This document reports the projected impacts of a vast increase in ethanol production on the U.S. oil refining industry. The premise of the work is a series of increases in ethanol (ETOH) production from current levels to more than 2.8 million barrels per day by the 2010-2015 period. It is estimated that this level of ethanol output would represent approximately 40% of the expected gasoline volume in the U.S. at that time.

There were four key issues which NREL has determined would be crucial to understanding the role of ethanol in the nation's fuel future. These are:

1. How does an increase in ETOH supply affect the price of gasoline and the balance of key blending components?

2. How does a large increase in ETOH use affect the demand for reformulated gasoline blending components?

3. How are middle distillate markets, for diesel and kerosene, affected by the increased use of ETOH?

4. What are the implications for crude oil demand and overall refinery economics?

To answer these questions, Meridian analysts used a national refining sector model and forced the requisite volumes of ETOH into both summer and winter gasoline pools. For the purposes of the analysis, it was assumed that the environmental standards that will affect gasoline in the late 1990s will continue through the period of the simulations. This analysis further assumes the use of Simultaneous Saccharification and Fermentation (SSF) technology with feedstock costs of $42/ton, yielding an ex factory gate wholesale ethanol production cost of $51/barrel or $1.21/gallon (in constant 1991 dollars). A base case was constructed against which the high ETOH scenarios could be compared. The key findings are summarized below:

- Without a program to mandate the use of large volumes of ETOH in the fuel supply or to drastically reduce ETOH prices, there will be little demand for ETOH beyond oxygenated fuels and gasohol demand. The economic level of ETOH demand is less than 125,000 b/d unless supplies of MTBE are restricted. Most of the ETOH would be used in the ethers, ETBE or ETAE, rather than in gasohol without a special RVP waiver for gasohol blends;

- Each 10% increment of $1.21/gallon ethanol into the gasoline pool will raise the average price of fuel in that pool by a minimum of $2.20 per barrel;

- Sensitivity analyses have shown that reductions in the price of ethanol to $37.80/barrel or $0.90/gallon have little impact on the petroleum side of the fuels

market. At this price, ethanol is still considerably more expensive than gasoline on an energy equivalent basis and more expensive then methanol for ether production;'

- Further ETOH price reduction to the DOE/NREL goal of $25.20/barrel or $0.60/gallon would increase the attractiveness of ethanol as a blend stock (i.e., in gasohol) in competition with low aromatic reformer output;

- Reductions in ETOH prices have a dramatic impact on the projected price of the gasoline pool, particularly when they approach $0.60/gallon;

- Crude oil runs at refineries will be cut by about 450,000-600,000 b/d for each 10% penetration of ETOH into the gasoline market. Such decreases in refined product demands could lower U.S. foreign oil dependence, even though the U.S. will face declining domestic crude production, but would force some refiners out of business;

- Middle distillate production will become more costly as the same volume of demand is to be met from reduced crude runs at refineries. Considerable additions to hydrocracking capacities, perhaps as much as 50%, will be required by the 2010 period;

- The costs of meeting middle distillate demand from cracking operations could rise by $1.00-1.75 per barrel of output by the time ETOH penetrates 30-40% of the gasoline market;

- Imports of LPGs, middle distillates and cracking feeds will all rise as crude oil volumes fall in response to reduced gasoline demand;

- At the 10-20% levels of market penetration, meeting the demand for reformulated fuels will lead to severe refinery bottlenecks due to reduced crude oil throughput. Additional costs will run in the range of $4.00 per barrel of gasoline. Once the volume of gasoline demanded is reduced considerably, it will cost only an additional $1.00-1.50 per barrel to meet the demands for reformulated fuels.

- At high levels of demand, ethanol substantially changes the complexion of the gasoline fraction of the motor fuel market. However, unless the price of ethanol is at the lowest target level, none of these changes will be spontaneous. That is, until ethanol is about 75% the price of gasoline on a volumetric basis, it will not be demanded, even for high efficiency dedicated vehicles, absent incentives. For multi-fuel vehicles, the ethanol must be no more than 60% the price of gasoline to be demanded in the market.

If ethanol reaches the target price of 60¢ per gallon, there will be some significant change in the composition of the petroleum side of the market in response. Gasohol will make up nearly 35% of the gasoline pool. The Table below shows the changes in composition of the gasoline pool at different ethanol prices (details of REFORM runs are found in Annex 2).

Table 1.1: How Ethanol Prices Interact With the Gasoline Market
(Winter Blend at 40% ETOH Volume Displacement)

	Price of ETOH		
Pool Component (% of petroleum pool)	**$1.21/gallon**	**$0.90/gallon**	**$0.60/gallon**
Oxygenates	8.17	9.90	9.69
Imported Gasoline	9.59	9.59	9.59
Reformate	27.11	17.65	13.75
FCC Naphtha	23.12	30.19	30.79
Other Naphthas	11.36	12.05	13.53
Gasohol (10% ETOH)	6.00	6.00	34.68
Cost of Petroleum Fraction ($/bbl)	29.80	29.70	29.40
Cost of Total Demand Barrel ($bbl)	38.38	32.94	27.72

Note: Column totals do not add to 100 since gasohol may contain FCCN and other blending components

- With more efficient and lower-cost production of fuel grade ethanol, there will be considerable savings for the gasoline pool as a whole. The cost of the overall demand barrel would be expected to fall by about $10.50/barrel as the $0.60/gallon ethanol is substituted for other components as gasohol and as its weight in the pool lowers overall prices rather than raising them. The lower cost ethanol reduces the cost of gasoline pool requirements somewhat by allowing refiners to use lower priced naphthas at higher levels in the pool. More importantly, lower priced ethanol, at a level of more than 2.8 million b/d, would act as a restraint on both crude oil and refined product prices. The one caveat here is that higher levels of ETOH production could drive up feedstock prices, thereby vitiating gains in process technology costs.

The above results point to significant impacts from increased use of neat ethanol fuels. However, the analysis does not consider several important items. These include the following:

1. Will large-scale use of ETOH be compatible with new engine technologies including advanced two-cycle engines and high efficiency diesels?

2. Will oxygenates still be required to cut CO emissions with the commercialization of advanced gasoline engine cycles?

3. How will the use of ETOH and CNG, both clean fuels, affect the environment and, hence, the requirements for reformulated gasolines and middle distillates?

4. How will CNG and neat ETOH compete in fleet and commercial markets? How does this competition affect distribution options for alcohol fuels?

5. Will ethanol be subject to tax and environmental (i.e., RVP) subsidies or will it obey the same environmental rules as other fuels?

6. What regional factors must be considered in mandating an alcohol fuels program?

7. Will increased supplies of alternative fuels cut into the demand for diesel by commercial operators?

8. Will advances in ethanol production technology permit the fuel to be an economically competitive fuel with respect to gasoline and CNG?

9. Will the downward pressure on world petroleum prices from low-cost ethanol yield additional systemic benefits to the overall U.S. economy and, if so, how should it be measured and valued?

These issues, though interesting and important, are beyond the scope of the current work. Some of them can be addressed under the existing analytical frameworks, including regionalized refining and gasoline market models.

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1.0 Introduction

One of the key ways to reduce oil demand in the United States is by substitution of non-oil energy forms for crude oil and refined products. This process is already well advanced in the electric power sector where coal provides about 63% of total power generation and nuclear/hydro another 20%. The transportation sector has remained stubbornly immune to non-oil fuels. Essentially, there are three alternatives for private vehicles. These are:

1. Electricity;

2. Natural gas, as CNG; and

3. Alcohols fuels in dedicated fuel or flexible-fueled vehicles.

This report contains the results of an investigation of the third option, replacement of significant portions of the gasoline market by ethanol (ETOH). No attempt was made to compare the ethanol option with the other two in terms of cost, emissions, energy security, or other desiderata. In addition, there was no attempt to determine whether the current Clean Air Act Amendments which mandate reformulated gasoline would require revision in light of the widespread use of ethanol. This question, though extremely important, is beyond the scope of the current work.[1]

The analysis that was undertaken considers the replacement of gasoline by ethanol in 10% increments, up to 40%, or 2.9 million b/d gasoline equivalents (about 4.8 million b/d of ETOH). This buildup from the current level to about 2.8 million barrels per day, is assumed to require 15 years.[2] The key impacts of gasoline replacement that were of interest to NREL included the following:

- Price impact on motor fuels;
- Price and quantity impacts on other liquid fuels, including
  - kerosene & jet fuel

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[1] It is likely that such an analysis would require a combination of approaches, looking at fleet characteristics, emissivity of various fuels at different levels, and the costs of supplying different levels of the particular fuels.

[2] This report considers the volumetric displacement of gasoline fractions only. The exact gasoline equivalent displacement ratio depends on the energy value of the gasoline pool (lower with oxygenates, than with petroleum only) and the efficiency of the ethanol-using vehicles. In general, one gallon of ETOH will displace about 75-80% of a gallon of gasoline in a dedicated-fuel vehicle, while flexible fueled vehicles will achieve only about 60% of the gasoline volumetric efficiency while using ETOH. In either case, the economics of replacing gasoline with ETOH on a mass scale would be decidedly adverse and not of interest from either analytic perspective. Consequently, in this report it was assumed that dedicated-fuel ETOH vehicles would also incorporate other fuel saving features so that ETOH would, in effect, replace gasoline 1:1 on a vehicle-mile basis.

- diesel fuels
- butane and LPGs
- imports of crude and refined oils

- Impacts on refining process unit requirements and operational rates and overall impacts on the refining sector.

The analysis proceeded using Meridian's *REFORM*[3] model of the U.S. refining sector. This model was designed specifically to simulate the effects of alcohol fuels and oxygenates in the changing U.S. fuel mix. *REFORM* reports detailed results on the following areas of interest to this assignment:

- Cost impacts of various levels of ethanol on the pool of gasoline and spark ignition fuels;
- Changes in product and blending component values - e.g., C_4 components and light olefin feeds for various process unit feedstocks;
- Impacts of winter and summer gasoline quality and emissions standards on ETOH cost impacts;
- Effects of greater ETOH use on demand for MTBE and other ethers; and
- Imports of gasoline (plus stock effects) with different alcohol fuels programs.

[3] REFORM stands for Refinery Environmental Formulation Optimization Requirements Model, developed with funding by the Biofuels System Division, Office of Transportation Technologies, U.S. Department of Energy.

2.0 Methodology

The *REFORM* model uses the same linear optimization techniques that are common to the oil refining industry. *REFORM* contains two main analytical modules. The first is a model of the entire refining system of the country and shows the following process systems with respect to 12 different crude oils:

- Atmospheric distillation;
- Vacuum distillation;
- Thermal cracking
- Heavy oil cracking
- Fluid catalytic cracking
- Catalytic hydrocracking
- Alkylation
- Reforming
- Ether plants
- Gas plant operations

The distillation model shows results for both winter and summer modes of operation for the cracking plants and gives each process unit a choice of feedstocks in line with current capabilities. Other crude oils could be added to the model but the increase in analytical richness is slight after the 12 major types of crudes now used in the U.S. have been included.

The second module of *REFORM* undertakes the specific requirements of gasoline blending. This module is linked to many of the process units simulated in the distillation module and blends 17 different components into the finished gasolines. These 17 components include over 95% of the current content of finished gasolines in the U.S and are expected to account for

as much as 99% of future gasoline blends.[4] The gasoline blending model is capable of specifying gasoline by PADD and with regard to the following quality and emissions criteria:

- Octane - RON and MON
- Vapor pressure
- Aromatics
- Olefins
- Benzene
- Oxygen

The blending model achieves the desired types of gasoline blends at the lowest possible cost. Variants of the blending model include PADD-specific versions with gasoline quality specifications for each major market or EPA airshed in the PADD.[5] The solution method that is used iterates between the two modules until convergence is achieved.[6]

The model results are reported in two sheets for each of the modules. One sheet shows the particular results while the other performs a sensitivity analysis on the results to calculate the shadow prices of the constraints and the upper and lower bounds for the variables. Bounding the variables is necessary in order to fairly represent the technical options that might be open to a refiner at any given time. Otherwise, optimization solutions are apt to take extreme values that might be unattainable in practice.

In the Annex to this report the printouts of the base case and incremental runs are shown. For each case there are seven files printed. These are:

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[4] These blending components include oxygenates MTBE and ETBE from both foreign and domestic sources as well as ETOH for gasohol. The model then determines whether the tradeoffs in feedstocks call for imports of MTBE or production of ETBE vis-à-vis gasohol blending. In some of the simulations, the imported gasolines will be divided into a "green" import containing the requisite oxygen and low levels of aromatics, olefins and benzene, and a "dirty" gasoline with less attractive levels of these desiderata, but lower costs.

[5] These models were not used in the current case since regional specificity was not required. However, if future issues dictate the exploration of regional market penetration by renewable-based fuels, then the PADD-specific models can be used.

[6] The model allows considerable trading off among process units that are connected in the chain of production and conversion and use of the C_4 streams.

1. Gasoline blending module summary
2. Gasoline module results
3. Gasoline module sensitivity analysis
4. Distillation module cracking section (only)
5. Distillation module results
6. Distillation module sensitivity analysis
7. Graph of petroleum components of gasoline supply

3.0 Analysis of Impacts of Enhanced Ethanol Usage

The base case for this analysis is the complex option implementation of the Clean Air Act. This option is denoted "1996 Environmental Standards" in some of the simulation reports. In general, such a phrase will refer to the full implementation of the emissivity standards with regard to oxygen, benzene, sulphur, olefins, and aromatics. There are not yet standards on T_{90}, though recent research indicates that this figure is an important determinant of emissions.

Previous studies using the *REFORM* approach have shown that the composition of gasoline in the "complex option" era will change significantly from its current makeup. Presently, gasoline sold in the U.S. is comprised of the major fraction shown below in Table 3-1.

Table 3-1

Composition of Current Gasoline Pool
(Annual Average)

Component	Percentage of Gasoline Pool
Oxygenates	2-3
Reformate	28-33
Catalytic Naphtha (FCCN)	38-42
Other Naphthas	4-5
Alkylate	11-14
Butane	3-4
Imports	3-4

3.1 Base Case for Late 1990s

The reformulation requirements of the Clean Air Act will lead to some significant changes in the composition of the gasoline pool. In particular, the following changes are either under way or will be implemented shortly:

- Reformate will be subjected to benzene removal. Reforming severity will decline in summer to reduce aromatics content. Octane will fall as a result of reduced

severity. The proportion of reformate in the pool as well as absolute levels of reformate used will fall from current levels;[7]

- Catalytic cracked naphthas will fall slightly as a proportion of the remaining gasoline pool while the composition of the cracked naphthas will change by season and also by regulatory régime

  - If olefins are more strictly controlled than is expected currently, then light FCCNs, which are comprised of more than 40% olefins, will be used as feedstocks for other processes, including alkylation and etherification

  - If aromatics continue to be seen as the prime hazard in fuels, then heavy cracked naphthas, with 60% aromatics will be "deselected" catalytically

- Other naphthas should rise to 5-7% of the pool but will not increase much in absolute terms;

- Alkylates will be in great demand, particularly in summer when their combination of good octane, low aromatics, olefins, and benzene, makes the material relatively more valuable;

- Oxygenates and ethers should rise to about 10% of the gasoline pool as demand rises not only for oxygen but also for the low benzene, aromatics, and olefins levels that characterize oxygenates and ethers. Ethanol blending for gasohol will be restricted during the summer by the effects of ETOH on vapor pressure;

- Butanes will continue to be attractive during the winter but their high blending vapor pressures will drive summer use close to zero; and

- Imports of gasoline are expected to rise sharply, to around 7-10% of the pool, as some refiners choose to shut down rather than spend the funds necessary to comply with the Clean Air Act.[8]

To get a better idea of just how the CAA will change the gasoline pool in the late 1990s, Meridian analysts have constructed a base case for the winter and summer gasoline pools for that

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[7] Reduced reforming severity will reduce C_4 output along with octane. With C_4 demand in such other refinery operations as alkylation going up, this decline in reforming represents a potential refinery bottleneck.

[8] For some smaller refiners the current refinery setup might not have sufficient upgrading capability to permit addition of alkylation units. At the same time, these refiners could be forced to sell their gasoline output to larger refiners as an intermediate blending component..

period. These cases are national and do not show the particular gasolines that will be used in such airsheds as the South Coast Basin of California in high summer.[9] Another caveat regarding the *REFORM* results is that the model shows what is required to achieve a solution - i.e., the type of gasoline that will satisfy both quality and environmental constraints - at the requisite volumes. However, it is not certain that sufficient conversion capacity, especially for alkylates and ethers, can be constructed, particularly in PADD-5, where summer standards for vapor pressure and volatiles may be the most stringent. Table 3-2 below shows the major components of the pool in the late 1990s for both the summer and winter base cases.

Table 3-2

Composition of 1996-1997 Gasoline Pool

Component	Proportion of Gasoline Pool (%)	
	Winter	Summer
Oxygenates	10	11
Reformate	38	23
Catalytic Naphtha (FCCN)	14	24
Other Naphthas	15	11
Alkylate	9	17
Butane	3.5	2
Imports/Restocking	10	10

During the winter refiners must shift the operation of catalytic cracking units to meet the demand for distillate fuel oil. Thus the FCCN component of the pool will fall during the winter, especially in light of the large volumetric contribution required from ethers and oxygenates.

The base case crude oil price for this analysis is in the middle range of current predictions for that commodity in the late 1990s at $23.55/barrel for West Texas Intermediate,

[9] The *REFORM* model does base the average figures used on the particular types of gasolines that are required in each region of the country. For the gasolines particular to a region or a PADD, less highly aggregated versions of *REFORM* must be used.

the NYMEX marker crude.[10] With crude oil in that range, the prices of gasoline, distillate fuel oil, and kerosene will be as is shown in Table 3-3.

Table 3-3

Base Case Refined Product Prices

	Price ($/bbl)	
Product	Winter	Summer
Gasoline	29.99	30.21
Distillate Fuel Oil	32.51	28.87
Kerosene	31.88	29.54

For the purposes of this analysis, both of the middle distillate fuels will be treated as originating from the same pool. This small violation of reality will permit the reader to more clearly understand the effects of the changes in refinery operations as gasoline fractions are moved out of the refining mixture while middle distillate output must be maintained at its current levels.[11]

For the Summer gasoline blend several of the key constraints are binding in the base case. When a constraint is binding, it means that there is no way to increase output without changing the factors that comprise the constraint. The binding constraints include the following:

- Gasoline imports and destocking of 800,00 b/d;
- MTBE output and imports of almost 780,000 b/d;
- ETBE demand of over 72,000 b/d;
- Low severity reformate capacity of 1.5 million b/d;

[10] With WTI at $23.55/bbl, Arab light would be landed at the U.S Gulf Coast at about $22-23/bbl while Alaska North Slope crude would be landed at the Gulf for just over $19/bbl. The crude oil price used in the mid 1990s REFORM simulations is approximately equivalent to the DOE/EIA Annual Energy Outlook Reference Case crude oil prices for the late 1990s. By the 2010 period, the crude oil price in the simulation relative to the Reference Case to approach the DOE/EIA Low Oil Price/High Economic Growth Scenario.

[11] The reality is somewhat more complicated as the increased availability of some naphthas, freed up by reduced demand for gasoline and reformate fractions, will provide a greater incentive to jet fuel consumers to use that fraction in the jet fuel pool.

- Aromatics and benzene levels in the finished gasolines of 25% and 1%, respectively;
- Vapor pressure (RVP) of 8.25 or less; and
- Research octane number (RON) averaging 95 or more.

Oxygen is oversupplied during summer due to the usefulness of ethers as high octane, low RVP, low aromatics/olefins/benzene blending components. The demand for ETBE during the summer is due almost entirely to the low RVP standards during that season.[12] It is assumed in the model that the requisite ETBE capacity will be constructed. The only real alternative to such ETBE levels is a vast expansion in alkylation capacity.

The base case is predicated on the pure economics of the petroleum and alcohol fuels. The ETOH tax and RVP credits are not considered in determining the economic demand for alcohol fuels.[13] Without the 54¢ per gallon tax credit and the 1 point RVP waiver, no ETOH is used for gasohol blending in either summer or winter.

For the winter formulations, the key constraints are oxygen levels, aromatics and olefins, in addition to the normal gasoline blending considerations. Only the oxygen and benzene constraints are binding, among the emissions related measures. Domestic MTBE and ETBE supplies are both used to their limits, as is normal butane.

A gasoline pool that is 10% oxygenates is about $1.00 per barrel (2.5¢ per gallon) more expensive at the *ex refinery* level than is a barrel of non-oxygenated gasoline. Other changes due to the reformulation requirements include lower reformer severity, more gasoline imports, and reduced use of butanes. All of these changes together will add another 80¢ per barrel (2¢/gallon) to the *ex refinery* price of gasoline over current wholesale prices.

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[12] ETBE has a blending RVP that is 2-3 points lower than that of MTBE. In the SCAQMD, ETBE is required in Summer to meet the RVP standards that are actually *lower* than the blending RVP of MTBE. With the additional octane in ETBE, other lower cost components are displaced in the gasoline pool, mostly butanes and naphthas. However, ETBE is virtually the only "clean" material with a blending RVP below 6, crucial to meeting the summer fuel standards. The other low RVP components have higher aromatics or olefins levels.

[13] Demand for sufficient ETOH to make the case for each increment of ETOH production is accomplished simply by forcing the gasoline market to accept a given volume of ETOH. It is also assumed that there will exist vehicles capable of taking advantage of the octane properties of ETOH so that the volumetric efficiency loss associated with the use of the fuel is not serious. Otherwise, the price impacts of ETOH use at high levels will be far more serious than is reported in this study.

Price impacts at the pump should be in the range of 10¢ per gallon. Regional impacts should be greater than those shown in this report. In particular, the *ex refinery* level impacts in California's South Coast Air Quality Management District (SCAQMD) will range from $3.50-5.50 per barrel and could go higher if sufficient conversion capacity is not constructed in that region.[14]

The volume of ethanol in the petroleum fraction of the U.S. gasoline supply, in gasohol and as a feedstock for ETBE or ETAE, will be well under 100,000 b/d under the base case conditions discussed above. Methanol, as a component of MTBE, will exceed 300,000 b/d when all forms are taken into account. Not more than 1% of the gasoline pool will be made up of renewable-based fuels in the scenario outlined in the base case.

In order to make a significant market penetration, ethanol use will have to be mandated for the motor fuel system or methanol (prices will have to drop dramatically). The cases discussed below show how volumes of ethanol up to 40% of the gasoline pool might be accommodated. There are four cases in increments of 10% gasoline volume displacement. The analysis is designed to show the pure allocative impacts of a policy to increase the share of ethanol in the motor fuel supply. As such, there is no consideration of tax credits, RVP credits or other implicit or explicit subsidies to ethanol fuels. Further, it is assumed that the ethanol is used in pure form, except for a small amount of gasohol and ETBE use. Finally, the remainder of the gasoline pool that is not ETOH is assumed to meet the complex option requirements of the Clean Air Act Amendments.

3.2 10% Ethanol Market Penetration

In the first case, the Meridian Team looked at the effects of a replacement of 10% of the gasoline pool (by volume) with ETOH. Both summer and winter gasoline markets were analyzed, as in the base case. The middle distillate markets are required to meet the normal expected demand while the volume of oil that is refined declines by 5-6%. This first stage is achievable, given some investment in the refining system beyond what is planned for gasoline reformulation under base case assumptions. In particular, the following changes will need to be considered:

- Increasing hydrocracking capacity by 25% to produce more middle distillates from heavy fractions;
- Increasing imports of LPGs and greater use of field butanes to make up for the decline in C_4 fractions from falling catalytic reformer utilization;

[14] Previous investigations have shown that summertime gasoline in the SCAQMD must average over 30% alkylate or related compounds during the peak summer period.

- Increased imports and winter stockpiling of gasolines to meet the summer demand of more than 850,000 b/d for low emissivity fuels that are not refined in that season;

- Further expansion of alkylation capacity, to about 1.4-1.5 million b/d, to meet the demand for that fraction and to complement the operations of ether plants; and

- Full utilization of domestic etherification capacity of more than 475,000 b/d, using both ethanol and methanol feeds.

The price effects of increased ethanol utilization are relatively small at the 10% level of market penetration. The following key impacts will occur to refined product prices in the summer gasoline season:

- Average gasoline market prices will rise by over $2.00 per barrel; and

- Total motor gasoline sales will fall under 7 million b/d with the following composition of the remnant gasoline pool.

The composition of the gasoline pool in the summertime would change radically from the base case 1996-7 projection as is shown in Table 3-4.

Table 3-4

Late 1990s Summer Gasoline Pool
(with 10% ETOH in Dedicated Fuel Vehicles)

Component	% of Pool
Oxygenates	9.4
Reformate	18.6
FCCN	24.7
Other Naphthas	10.5
Alkylate	21.97
Butane	1.7
Imports/destocking	12.7

In particular, the high levels of alkylate that are required to meet the complex option will cause supply problems in other areas, most notably light olefin feeds. The binding constraints on quality and emissivity constraints including RON, oxygen, RVP, and benzene. In addition, the

required gasoline quality will push catalytic cracking capacity with the simultaneous requirement for ethers, FCCN, and alkylates at high levels. In effect, the FCC units become feedstock producers for other downstream units. The stress on the refining system is seen in the shadow price of additional gasoline supplies. This shadow price has been calculated by REFORM at over $34/barrel. The calculated shadow price is $4.00 per barrel above the average product cost and more than $2.00/barrel above the shadow price for the non-ethanol base case. If dedicated fuel vehicles are not used, then the amount of ETOH that is required to achieve a 10% level of gasoline volume displacement will rise from about 700,000 b/d to more than 1,000,000 b/d. This would add a minimum of another $2.50/barrel to the average cost of meeting demand in the gasoline pool.

The impacts on other fractions of the barrel are substantial. In addition to the substantial increases in imports of LPGs and middle distillates, hydrocracking capacity will have to increase even in the summer season when distillate fuels are typically put into stocks.[15] The hydrocracking units will not be operated at full capacity during the summer period but will be operated at a level considerably higher than is common today. At the 10% level of ethanol use, the increases in the calculated values of distillate fuel oils are slight. However, supplies of butanes and other light hydrocarbons will be affected by the reduction in catalytic reforming.

Winter gasolines will cost only slightly less on average than the summer blends, prior to the addition of ETOH to the pool. The addition of ethers to the fuel mixture along with stiff oxygen standards makes the winter blends more costly than without the program. As with the summer program, the mandatory addition of 10% ETOH to the motor fuel market will add about $2.10 to the average cost of such fuels *ex refinery*. The total required supply of conventional or reformulated gasolines in the winter should fall to about 6.5 million b/d. The remainder of the demand, about 700,000 b/d, will be ETOH used as neat fuel (see Table 3-5).

Sensitivity analysis shows that the shadow price of additional gasoline output will fall by more than the fall in average gasoline *ex refinery* prices. Whereas the fall in *ex refinery* prices is less than $1.00, the fall in the gasoline shadow price is a substantial $3.00/barrel.

[15] Reduced crude throughput reduces straight run middle distillate output. The required volumes of middle distillates must be produced through more aggressive catalytic and cracking operations.

Table 3-5

Late 1990s Winter Gasoline Pool
(with 10% ETOH in Dedicated Fuel Vehicles)

Component	% of Pool
Oxygenates	10.7
Reformate	39.4
FCCN	15.4
Naphthas	16.4
Alkylate	9.6
Butane	3.9
Imports/destocking	3.9

The key limitations in the refining system include naphtha supplies, hydrocracking capacity and other heavy oil upgrading technologies. The shadow price for additional middle distillate supplies is well above the expected market price of about $30.00/barrel, at $41/barrel. Similarly, the heavy demands on naphtha supplies raise its shadow price substantially to about par with gasolines and middle distillates.

These shadow prices represent values at the margin and do not represent average costs. However, a high shadow price for a fraction relative to its price is usually a good indicator of substantial disequilibrium in the refinery system. Shadow prices on capacity show similar disequilibria, with the shadow prices of feedstock-producing processes quite high. Such high shadow prices are caused by the requirement to supply feedstocks for upgrading units in spite of a reduction in crude oil runs.

The winter emissivity standards used in this case permit relatively high levels of aromatics and olefins in the winter gasoline blend. With large butane supplies from a high utilization of reforming capacity, reformates and butanes together comprise 43% of the total pool. Conversely, alkylates are down considerably, to about 10% of the pool. It is expected that the more permissive winter emissivity standards will allow greater use of refinery naphthas in the blend.[16]

[16] This might reduce the potential for octane giveaway in the winter.

3.3 20% Gasoline Volume Displacement by Ethanol

It is expected to take about five years to achieve a doubling of ethanol output to 1.4 million b/d (21 billion gallons/year) from the 10% level of gasoline volume displacement. This period of time would also be required to permit the refining system to undertake additional substantial modifications engendered by such massive replacement of gasoline.

Among the most significant structural changes in the U.S. refining system in response to a mandate to replace 20% of the gasoline pool with ETOH, would be the following:
Reduction in crude oil runs of 8-9%;

- Increase in hydrocracking capacity of 35%;
- Increase in LPG imports of 50%; and
- Shortages of upgradeable heavy feedstocks for cracking operations.

In the 20% case, results are given for winter gasolines only. At levels of ethanol market penetration of 20% or greater, the required changes to the summer gasoline pool are so massive that the problems become analytically intractable.[17] In particular, it becomes difficult to achieve the appropriate levels of aromatics and olefins in the blend without "inventing" new catalysts for the FCC units and for catalytic reformers.[18] For the three higher level cases, the summer gasoline blends are computed only for the 30% ETOH market penetration.

The composition of the pool is expected to shift considerably from the previous cases. There are two main reasons for this shift. The first is the strain on feedstock supplies as olefin feedstock demand rise and as clean middle distillate fuels must be supplied in ever-greater volumes. The second is that the emissivity standards for winter gasolines will tighten by the time ETOH can reach 20% of the pool.[19]

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[17] A summer solution was computed to the 30% volume displacement case. However, this solution is more of an exercise than an expected outcome. Clearly, by the time such significant volumes of alternative fuels are available, it will be necessary to rethink the overall gasoline reformulation program. It is conceivable that large scale use of ETOH and CNG could obviate the need for much of the proposed reformulation of the gasoline pool. In that event, savings of capital investment and in the operation of refineries could save several billion dollars per year.

[18] Such new catalysts are currently under development and many will undoubtedly ease the burden for compliance with mandated substitute fuels. However, at the present time such catalysts do not exist and modeling of their behavior is specious.

[19] In a sense the reader may look upon these cases as being similar to the summer simulations but with higher vapor pressure allowances.

The particular changes in pool composition that will be most significant given the changes in marketed volumes of fuels and of relevant quality and emissions standards include the following:

- Oxygenates will rise as a fraction of the pool but will remain about steady on an absolute basis;
- FCC naphthas will fall both relatively and absolutely as these products become largely feedstocks for etherification and alkylation;
- Reformates will fall by 300,000 b/d in absolute terms and will decrease from almost 40% of the pool to 31%;
- Naphthas will rise sharply as a fraction of the pool since they will be surplus in the refinery system; and
- Imports of finished gasolines will increase sharply, even during winter, as falling crude oil runs lead refiners to reduce gasoline output in favor of middle distillates.

From the sensitivity analysis it appears that winter gasoline can continue to be produced at about the same cost as under the 10% volume displacement mandate. This is seen from the gasoline shadow price which remains at $31/barrel. With reduced volumes of gasoline required, the benzene and aromatics limitations are not binding and expensive constraints as they are in the base case.

Table 3-6 below shows the expected composition of the winter gasoline pool under a 20% ETOH mandate.

Table 3-6

Early 2000s Winter Gasoline Pool
(with 20% ETOH in Dedicated Fuel Vehicles)

Component	% of Pool
Oxygenates	12.9
Reformate	13.7
FCCN	13.9
Other Naphthas	16.9
Alkylate	9
Butane	3.5
Imports/destocking	11.1

For the refining sector as a whole, the key constraints on output are the following:

- Naphtha outputs from cracking operations;
- Hydrocracking capacity - even with a 35% increase in such capacity to over 620,000 b/d;
- Atmospheric residual feeds for cracking; and
- Vacuum gasoil feeds for cracking.

Less refining throughput clearly means less residuum and less feed for the vacuum distillation units. It is possible, then, that U.S. refiners will either reduce cracking throughput or else purchase feedstocks from foreign refiners, especially those in the Caribbean.

The difficulty in meeting naphtha and middle distillate output levels is reflected in the high shadow prices, $42/barrel and $49/barrel, respectively, that are attributed to those fractions. In addition, the shadow price of additional hydrocracking capacity is extremely high, reflecting the difficulties in meeting middle distillate demands with reduced crude oil runs.

3.4 30% Gasoline Volume Displacement by Ethanol

Simulations of high levels of gasoline volume displacement were prepared for both summer and winter gasoline blends. As before, it is assumed that the ETOH is used in 100% alcohol fueled vehicles. The use of more than 2.1 million b/d of ETOH will bring the demand for conventional gasolines down to just over 5 million b/d in winter and 5.4 million b/d in

summer. The volume of ETOH used varies so that it is always 30% of the total pool requirement.

In the winter gasoline case, the composition of the pool shifts from the earlier cases so that reformates and FCC naphthas take up a larger proportion of the pool than was the case under the winter blend at 20% ETOH. The smaller pool requirements, combined with the other demands on reformers and FCC units for feedstock production raise FCC naphthas to more than 24% of the pool. Reformate should fall due to the aromatics and benzene constraints while imports and use of other naphthas falls as well. Table 3-7 shows the simulated gasoline pool with 30% ETOH volume displacement.

Table 3-7

Early 2000s Winter Gasoline Pool
(with 30% ETOH in Dedicated Fuel Vehicles)

Component	% of Pool
Oxygenates	12.01
Reformate	19.36
FCCN	24.33
Other Naphthas	14.24
Alkylate	12.38
Butane	4.95
Imports/destocking	11.89

The key binding constraints in the analysis are RVP and benzene levels. Other constraints may be at maxima or minima but only two constraints delimit the solution. The shadow price of gasoline rises by $1.00/barrel over the base case, to $32/barrel. Average *ex refinery* gasoline prices remain under $30/barrel. However, the overall cost of motor fuel in the gasoline pool rises to more than $36.00/barrel, due to the mandated use of ETOH.[20]

For the rest of the refining sector, additional costs of meeting demand for middle distillates and other fractions from a shrinking crude oil supply mean significant additional costs to the refining sector. The additional daily cost of more severe cracking and upgrading could add as much as $9 million to the daily cost of supplying middle distillates, butanes and naphthas.

[20] The reader should note that the figures given for the price impacts of ETOH represent best cases to the extent that it is assumed that most of the energy deficit of ETOH relative to gasoline will be mitigated by higher compression engines, producing more power from a given amount of energy.

This sum represents the differential between the cost of running the cracking operations under the base case with the cost of those operations in the 30% ETOH case. The results of the analysis show that reduced crude oil runs put more call on producing middle distillates from catalytic and cracking operations. Consequently, the constraints on heavy feedstock supplies for cracking units were all binding or close to binding. As with the 20% case, it is likely that imports of residual oils and heavy gasoils will be necessary to provide sufficient feed to cracking units to meet the demands for middle distillate fuels. As with the previous case, the shadow price on additional hydrocracking capacity is quite high, indicating continuing disequilibrium between demand and supply of middle distillates.

The summer blends of gasoline show considerable strains in the supply system. The primary problem remains one of manufacturing sufficient upgraded materials from a shrinking resource pool. As with most summer blends, most of the emissivity constraints are binding, even with large supplies of ethers and "green gasoline" imports.

The average *ex refinery* price of summer gasoline blends is almost 50¢ per barrel higher than the winter gasoline. The cost of meeting winter middle distillate demands will reduce the traditional gap of $1.50-2.00 between summer and winter gasolines almost to zero. The ETOH adds at least $6.25 per barrel to the cost of meeting motor fuel demand and the average cost of motor fuel rises in summer to $36.58 per barrel. This figure of $6.25 per barrel is based on the 1:1 equivalence. Using ETOH in flexible fueled vehicles would add another $8-10 per barrel to the cost of meeting the pool requirements by increasing ETOH requirements to more than 3 million b/d. In other words, without significant efficiency increases in the ETOH vehicles, large scale market penetration of that fuel could lead to price increases for the gasoline market of as much as $15 per barrel of fuel. On the other hand, a reduction in ETOH costs to $0.90 per gallon would reduce the additional costs of using ETOH to a range which might vary from about $4.50 per barrel to $10.00 per barrel, depending on the assumptions about the efficiency of using the ETOH.

Table 3-8 below shows the composition of the petroleum fraction of average summer gasolines with a 30% ethanol mandate.

Table 3-8

Early 2000s Summer Gasoline Pool
(with 30% ETOH in Dedicated Fuel Vehicles)

Component	% of Pool
Oxygenates	11.2
Reformate	25.27
FCCN	23.37
Other Naphthas	12.82
Alkylate	15.67
Butane	1.38
Imports/destocking	9.58

One of the clear results of the analysis is that with time refiners can adjust the types of cracked and reformed naphthas that comprise the gasoline pool to make the emissivity of such components lower. For example, the total demand for oxygenates is proportionately lower for less absolute oxygenate use than was the case for the 20% ETOH mandate. At the same time, the demand for reformulated imports shows a substantial fall in both percentage and absolute volume.

In the shadow price analysis of the summer gasoline supplies, additional gasolines can be supplied at a relatively modest incremental price of $32/barrel. For example, meeting the benzene constraint, which costs the refining system several hundred dollars per barrel of benzene removed in the late 1990s simulations, falls to just $54/barrel in the 30% mandated case.
As in the previous cases of high ethanol requirements, the demand for hydrocracking capacity shows continuing stress, even at 644,000 b/d of stream capacity. Due to seasonal factors, the cost of meeting the middle distillate and cracking demands is about $4 million per day below the winter period. However, this cost is almost $3 million per day above the base case summer supply scenario.

In the cracking model, the key constraints are naphtha supplies, butane balance, hydrocracking capacity and feedstocks for cracking and catalytic operations. With lower gasoline demands, these constraints are less pressing than in the winter or with more competition from the gasoline pool. The naphtha shadow price shows a substantial fall from the previous levels, back to $33/barrel and the middle distillate shadow price falls from $49/barrel to $42/barrel in this case.

3.5 40% Gasoline Volume Displacement by Ethanol

The final case examined is one where 40% of the gasoline market is replaced with ETOH. Beyond such penetration levels, the number of relevant variables escalates and analytical solutions become scarce.[21] Only a winter analytical solution was attempted for this case since the summer gasoline case is critically dependent on assumptions about fuel emissivity levels that are not known at this time.

The winter gasoline blend produced by the model simulation is similar to the 30% case. Lower gasoline volume means a smaller oxygenate requirement and, consequently, more reformate is used in this blend than in the previous winter gasoline cases.

The average cost of supplying gasoline remains at previous levels, $29.80 per barrel.[22] The addition of ETOH increases the average price of fuel by more than $8.50/barrel, to $38.38 per barrel. If the ETOH were to be used in FFVs, the impact on the cost of the gasoline pool would increase by at least $10 per barrel over the $38.38 per barrel figure. Of the binding constraints, only the volume requirement itself and the benzene level will cost much to attain. The other binding constraints can apparently be met easily with the expected refinery configuration at that time. Table 3-9 presents the expected composition of the gasoline pool in the 2010-2015 period when over 40 billion gallons of ETOH could be used annually as motor fuel.

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[21] For example, by the time more than 2.8 million b/d of ethanol went to the market, other alternative fuels could also have gained large market share. In particular, compressed natural gas and two cycle engines may reduce the potential market that is apparently available to ETOH. Further advances in conventional Otto cycle engines could also reduce the need for reformulated fuels. Other variables include the octane requirements of future fuels. Such imponderables were not considered in the present analysis.

[22] The crude oil price that is used in the 40% Gasoline Volume Displacement Scenario is consistent with DOE projections of oil prices under conditions when there is an abundant supply of alternative fuels. This massive displacement of oil-derived gasoline in the U.S. is expected to lead to a softening of the world price for oil.

Table 3-9

2010-2015 Winter Gasoline Pool
(with 40% ETOH in Dedicated Fuel Vehicles)

Component	% of Pool
Oxygenates	8.17
Reformate	27.11
FCCN	23.12
Other Naphthas	11.36
Alkylate	14.59
Butane	4.93
Imports/destocking	9.59

Among the key changes noted in this scenario are the following:

- Imports of gasolines are greatly reduced from late 1990s levels, falling to just over 400,000 b/d from late 1990s levels of more than 700,000 b/d;
- Butanes become desirable again as fuel additives as other low RVP components permit the addition of more butanes to the petroleum fraction of the gasoline market;
- Alkylates continue to occupy a substantial role in the winter fuel market, a situation far different from the current situation;
- Oxygenates fall as a proportion of total demand to less than 10% as the octane in the oxygenates is no longer needed; and
- Low severity reformates dominate that fraction of the barrel, comprising about three-fourths of the reformate pool. Heavy reformates face little demand given their high aromatics contents and the reduced octane demand.

Meeting a static middle distillate demand from a falling crude oil slate continues to be costly for cracking and catalytic operations. As in the previous cases, the key limitations are feedstocks for the catalytic units and hydrocracking capacity. In the current scenario, hydrocracking capacity is required to rise by 75% over the late 1990s base case. With lower reformer severity, LPG imports or additional provision of field butanes is required to meet the demand for C_4s in cracking and in other operations. As in previous cases, both the C_4 and

naphtha demands on the cracking operations are binding. However, due to the lower level of gasoline demand, the shadow prices for distillate fuels, butanes and feedstocks are far lower than in the previous cases. These low shadow prices indicate that with time and with large expenditures in constructing hydrocrackers, the refinery system can achieve some degree of equilibrium.

There are three reasons why the reduced demand for gasoline allows an equilibrated system in the later stages. These are:

1. FCC naphtha demand for the gasoline pool is only 55% of the level in the base case runs. This reduces the demand for cracking feedstocks;

2. A buildup of hydrocracking capacity produces naphthas that can be blended into the gasoline pool, reducing the demand for other naphthas; and

3. FCC units can be run for middle distillate output given the reduced demand for FCC naphthas.

3.6 Issues Not Addressed By This Analysis

There are still a substantial number of issues that must be considered in looking at massive substitution of alcohol fuels for conventional gasolines. Some of these issues are logistical while others are technological or economic. The most important of these issues which remain unaddressed include the following:

1. Will mass use of ETOH be compatible with new engine technologies including advanced two-cycle engines and high efficiency diesels?

2. Will oxygenates still be required with advanced gasoline engine cycles to cut CO emissions?

3. How will the use of ETOH and CNG, both clean fuels, affect the environment and, hence, the requirements for reformulated gasolines and middle distillates?

4. How will CNG and neat ETOH compete in fleet and commercial markets? How does this competition affect distribution options for alcohol fuels?

5. Will ethanol be subject to tax and environmental (i.e., RVP) subsidies or will it obey the same environmental rules as other fuels?

6. Will environmental limitations on cultivation of ETOH feedstocks restrict supplies?

7. Will increased supplies of alternative fuels cut into the demand for diesel by commercial operators?

8. Will advances in ethanol production technology permit the fuel to be an economically competitive fuel with respect to gasoline and CNG?

The questions just raised are beyond the scope of the present analysis. However, it is conceivable that a more thorough examination of some of these issues is in order. In particular, the interaction among ETOH, CNG, and diesel is crucial to assessing the scope of ethanol fuel's impacts on the refining system. In the environmental sphere, it is crucial to understand how the further use of clean fuels will change the requirements to reformulate or otherwise clean up conventional fuels.

ANNEX 1

VALUES AND SENSITIVITY

RUNS FOR 0-40%

ETHANOL VOLUME

Annex: *REFORM* Model Results

The printouts that follow contain the detailed data and results from the *REFORM* modeling effort. The codes for the answer and sensitivity filenames are as follows:

abc-x.XLS, where:

The first letter denotes the model that created the data, *S* for the gasoline blending model, *D* for the distillation and cracking model;

The second letter denotes the contents of the model, *A* for answers, *S* for sensitivity;

The third letter denotes the season, *S* for summer and *W* for winter;

The term after the dash denotes the percentage of ETOH in the fuel supply.

Thus, the filename, DAW-ten.XLS is the distillation model results for winter at 10% ETOH.

In looking at the solutions tables from the various runs of REFORM, interpretation is straightforward. In the Answer Reports, the "Final Value" column in the first two sections shows the final result for that run of the model. That is, the final value of the Target Cell section shows the overall cost (in $ per day) of meeting the petroleum gasoline market requirement. In the next section, the Final Values show the levels of the various blending components in barrels. These numbers correspond to the solution values in the spreadsheet printout of the blending model run.

The third section of the Answer Report shows whether the key constraints on volume and fuel quality were binding. If they were not, then the "Slack" column shows the amount by which that row in the blending model could still rise. The first 13 of these constraints relate to the blending components and fuel quality characteristics available to the model. The second set of constraints refers to the upper and lower bounds of the variables for each of the blending components.

The Sensitivity Reports show the value (shadow price) of changing any constraint or bound in dollars. If this value is 0, then the constraint is not binding and output can be increased without affecting that characteristic of the pool. These reports can be understood by those familiar with such models when used in conjunction with the blending model printout. For the distillation model, the reports should also be used in conjunction with the relevant model printout. Otherwise, it is difficult to determine the variable that is subject to a constraint or bound.

Winter Gasoline Blend — No ETOH — 1996 Environmental Standards

Obj. F'n. Values ($/bbl)	31.21	34.33	29.73	30.02	30.52	29.57	24.69	31.45	29.88	30.69	51.24	36.96	38.46	38.81	18.52
				Variables											
Constraint	Reformate Full	Reformate Heavy	Reformate "LITE"	FCCN Full	FCCN Light	FCCN Heavy	SR Naphtha	IG-1 Imported	IG-2 Imported	Alky-Poly	ETOH	MTBE	MTBE Imported	ETBE	N-butane
Volume: LB	1608713	150000	1000000	500000	250000	250000	867852	250000	450000	625000	0	402975	255008	72279	250000
Volume: UB	1608713	150000	1000000	500000	250000	250000	867852	250000	450000	625000	0	402975	255008	72279	250000
FCCN	0	0	0	909091	490196	408163	0	0	0	0	0	0	0	0	0
Reformate	1986068	230769	1136364	0	0	0	0	0	0	0	0	0	0	0	25000
Olefins	11261	750	50000	145500	99500	41250	13018	25000	49500	31250	0	0	0	0	0
Aromatics	1007055	130800	350000	146000	33750	150750	60750	68750	148500	25000	0	0	0	0	6750
Oxygen	0	0	0	0	0	0	0	5625	9000	0	0	73341	46411	11348	0
MON	140601539	14175000	85000000	40350000	20200000	20325000	63353197	21750000	37800000	56937500	0	41103450	26010783	7444728	22400000
RON	157171286	15735000	95000000	46050000	23150000	22975000	65068901	24500000	41625000	58250000	0	47148075	29835896	8601190	23550000
RVP	16087133	405000	8000000	3550000	2475000	650000	10414224	2500000	4612500	4687500	0	3143205	1989060	361395	13750000
Lt. Olefin Feed	0	0	0	0	0	0	0	0	0	718750	0	317303	0	49508	0
Benzene	16087	3000	7500	7500	3125	5000	13018	1875	4050	3125	0	0	0	0	0
Ethanol	0	0	0	0	0	0	0	0	0	0	0	0	0	30694	0
Lower Bound	150,000	150,000	250,000	500,000	250,000	250,000	125,000	0	0	625,000	0	0	0	0	0
Upper Bound	2,250,000	500,000	1,000,000	1,750,000	800,000	975,000	2,100,868	250,000	450,000	1,532,486	7,339	402,975	375,000	72,279	250,000
Objective Function		2.162E+08													
Variables	1608713	150000	1000000	500000	250000	250000	867852	250000	450000	625000	0	402975	255008	72279	250000

Mixing Values	Benzene	Aromatics	Olefins	Oxygen	RVP		Oxygenate	FCCN	Tol/Xy	Reformate	Butane	Alky	Imports	Naphthas
	1.00%	30.36%	6.50%	2.02%	10.44		730,262	1,000,000	60,792	2,758,713	250,000	625,000	700,000	1,085,234
							10.13%	13.87%	0.84%	38.26%	3.47%	8.67%	9.71%	15.05%
Octane Values														
RON	98	105	95	92	93	92	75	98	93	93	106	117	117	119	94
MON	87	95	85	81	81	81	73	87	84	91	89	102	102	103	90

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/28/92 12:41

Target Cell (Min)

Cell	Name	Original Value	Final Value
$D$25	Objective Function Heavy	2.162E+08	2.162E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	1608588	1608713
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	1000000	1000000
$F$27	Variables Full	500000	500000
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	250000	250000
$I$27	Variables Naphtha	868013	867852
$J$27	Variables Imported	250000	250000
$K$27	Variables Imported	449999	450000
$L$27	Variables Alky-Poly	625000	625000
$M$27	Variables ETOH	0	0
$N$27	Variables MTBE	402975	402975
$O$27	Variables Imported	255007	255008
$P$27	Variables ETBE	72279	72279
$Q$27	Variables N-butane	250000	250000
$R$27	Variables Xylene	60774	60792
$S$27	Variables & Cnap	217382	217382

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	7,210,000	$V$7<=$W$7	Not Binding	7,210,000
$W$8	< Current Level	7,210,000	$W$8<=$V$8	Not Binding	1,802,500
$W$9	< Current Level	1,807,450	$W$9<=$V$9	Not Binding	3,592,550
$W$10	< Current Level	3,378,199	$W$10<=$V$10	Not Binding	621,801
$W$11	< Current Level	468,550	$W$11<=$V$11	Not Binding	612,950
$W$12	< Current Level	2,189,082	$W$12<=$V$12	Not Binding	334,418
$W$13	> Current Level	145,726	$W$13>=$V$13	Binding	0
$W$14	> Current Level	621,627,735	$W$14>=$V$14	Not Binding	590,613,909
$W$15	> Current Level	684,950,000	$W$15>=$V$15	Not Binding	684,950,000
$W$16	< Current Level	75,306,546	$W$16<=$V$16	Not Binding	398,454
$W$17	< Current Level	1,085,559	$W$17<=$V$17	Not Binding	613,175
$W$18	< Current Level	72,100	$W$18<=$V$18	Binding	0
$W$19	< Current Level	30,694	$W$19<=$V$19	Not Binding	18,230
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	3,067,427
$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	1,750,000

Summer Gasoline Blend — No ETOH — 1996 Environmental Standards

Obj. F'n. Values ($/bbl)	31.21	34.33	29.73	30.02	30.52	29.57	24.69	31.45	29.88	30.69	51.24	36.96	38.21	38.81	18.52
				Variables											
Constraint	Reformate Full	Reformate Heavy	Reformate "LITE"	FCCN Full	FCCN Light	FCCN Heavy	SR Naphtha	IG-1 Imported	IG-2 Imported	Alky-Poly	ETOH	MTBE	MTBE Imported	ETBE	N-butane
Volume: LB	150000	150000	1500000	766530	250000	857680	661503	450000	350000	1320538	0	402975	375000	72279	155931
Volume: UB	150000	150000	1500000	766530	250000	857680	661503	450000	350000	1320538	0	402975	375000	72279	155931
FCCN	0	0	0	1393690	490196	1400295	0	0	0	0	0	0	0	0	0
Reformate	185185	230769	1704545	0	0	0	0	0	0	0	0	0	0	0	15593
Olefins	1050	750	75000	223060	99500	141517	9923	45000	38500	66027	0	0	0	0	0
Aromatics	93900	130600	525000	223827	33750	517181	46305	123750	115500	52822	0	0	0	0	4210
Oxygen	0	0	0	0	0	0	0	9000	7000	0	0	73341	68250	11348	0
MON	13110000	14175000	127500000	61858940	20200000	69729423	48289704	39150000	29400000	120300996	0	41103450	38250000	7444728	13971376
RON	14655000	15735000	142500000	70597377	23150000	78820838	49612710	44100000	32375000	123074126	0	47148075	43875000	8601190	14688656
RVP	1500000	405000	12000000	5442360	2475000	2229969	7938034	3487500	2800000	9904034	0	3143205	2925000	361395	8576179
Lt. Olefin Feed	0	0	0	0	0	0	0	0	0	1518619	0	317303	0	49506	0
Benzene	1500	3000	11250	11498	3125	17154	9923	2250	2625	6603	0	0	0	0	0
Ethanol	0	0	0	0	0	0	0	0	0	0	0	0	0	30694	0
Lower Bound	150,000	150,000	250,000	500,000	250,000	250,000	125,000	0	0	625,000	0	0	0	0	0
Upper Bound	2,250,000	500,000	1,500,000	1,750,000	800,000	975,000	2,100,868	450,000	350,000	1,532,486	7,339	402,975	375,000	72,279	250,000
Objective Function		2.342E+08													
Variables	150000	150000	1500000	766530	250000	857680	661503	450000	350000	1320538	0	402975	375000	72279	155931

Mixing Values	Benzene	Aromatics	Olefins	Oxygen	RVP		Oxygenate	FCCN	Tol/Xy	Reformate	Butane	Alky	Imports	Naphthas	
	1.00%	25.00%	9.06%	2.18%	8.50		850,254	1,874,210	70,933	1,800,000	155,931	1,320,538	800,000	878,884	
							10.97%	24.18%	0.92%	23.22%	2.01%	17.04%	10.32%	11.34%	
Octane Values															
RON	98	105	95	92	93	92	75	98	93	93	106	117	117	119	94
MON	87	95	85	81	81	81	73	87	84	91	89	102	102	103	90

30.17	24.07

Toluene/ Xylene	Isomerate & Cnap	<,>,=	Level	Current Level	Constraint In Units/bbl	Constraint
70933	217382	>	7,750,750	7,750,750	7750750	Volume: LB
70933	217382	<	9,688,438	7,750,750	9688438	Volume: UB
0	0	<	5,400,000	3,284,181	5400000	FCCN
0	0	<	4,000,000	2,136,093	4000000	Reformate
0	1522	<	767,347	701,849	0.102	Olefins
67599	3043	<	1,937,688	1,937,688	0.250	Aromatics
0	0	>	84,812	168,939	0.011	Oxygen
7157161	18042675	>	651,543,822	669,683,453	84.062	MON
7823933	19564348	>	736,321,250	736,321,250	95.000	RON
85120	2608580	<	65,881,375	65,881,375	8.500	RVP: Max
0	0	<	2,310,864	1,885,427	2310864	Light Olefin Feed
5320	3261	<	77,508	77,507	0.010	Benzene
0	0	<	48,924	30,694	7.500E-01	ETOH Prod.
0	0		2300000	Lower Bound Total		
75,000	217382		13608328	Upper Bound Total		

		Total Mogas (b/d)	Average Cost ($/bbl)
70933	217382	7,750,750	$30.21
			Average cost ($/gal)
			$0.719
			Total ETOH Used
			0
			Average Cost of Motor Fuel ($/bbl)
			$30.21

Subtotal		
7,750,750		
100.00%		Final
		Octane
110	90	95
101	83	84

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/28/92 14:25

Target Cell (Min)

Cell	Name	Original Value	Final Value
$D$25	Objective Function Heavy	2.342E+08	2.342E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	150000	150000
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	1500000	1500000
$F$27	Variables Full	773141	766530
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	855355	857680
$I$27	Variables Naphtha	660908	661503
$J$27	Variables Imported	450000	450000
$K$27	Variables Imported	350000	350000
$L$27	Variables Alky-Poly	1317398	1320538
$M$27	Variables ETOH	0	0
$N$27	Variables MTBE	402975	402975
$O$27	Variables Imported	375000	375000
$P$27	Variables ETBE	72279	72279
$Q$27	Variables N-butane	155753	155931
$R$27	Variables Xylene	70559	70933
$S$27	Variables & Cnap	217382	217382

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	7,750,750	$V$7<=$W$7	Not Binding	7,750,750
$W$8	< Current Level	7,750,750	$W$8<=$V$8	Not Binding	1,937,688
$W$9	< Current Level	3,284,181	$W$9<=$V$9	Not Binding	2,115,819
$W$10	< Current Level	2,136,093	$W$10<=$V$10	Not Binding	1,863,907
$W$11	< Current Level	701,849	$W$11<=$V$11	Not Binding	85,498
$W$12	< Current Level	1,937,688	$W$12<=$V$12	Binding	0
$W$13	> Current Level	168,939	$W$13>=$V$13	Not Binding	84,127
$W$14	> Current Level	669,683,453	$W$14>=$V$14	Not Binding	633,404,191
$W$15	> Current Level	736,321,250	$W$15>=$V$15	Not Binding	736,321,250
$W$16	< Current Level	65,881,375	$W$16<=$V$16	Binding	0
$W$17	< Current Level	1,885,427	$W$17<=$V$17	Not Binding	2
$W$18	< Current Level	77,507	$W$18<=$V$18	Binding	0
$W$19	< Current Level	30,694	$W$19<=$V$19	Not Binding	18,230
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	150,000
$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	2,750,000

$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	1,033,059
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	1,465,361
$I$21	Lower Bound Naphtha	125,000	$I$21<=$I$27	Not Binding	1,198,006
$J$21	Lower Bound Imported	0	$J$21<=$J$27	Not Binding	900,000
$K$21	Lower Bound Imported	0	$K$21<=$K$27	Not Binding	700,000
$L$21	Lower Bound Alky-Poly	625,000	$L$21<=$L$27	Not Binding	2,016,076
$M$21	Lower Bound ETOH	0	$M$21<=$M$27	Binding	0
$N$21	Lower Bound MTBE	0	$N$21<=$N$27	Not Binding	805,950
$O$21	Lower Bound Imported	0	$O$21<=$O$27	Not Binding	750,000
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Not Binding	144,558
$Q$21	Lower Bound N-butane	0	$Q$21<=$Q$27	Not Binding	311,861
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Not Binding	141,866
$S$21	Lower Bound & Cnap	0	$S$21<=$S$27	Not Binding	434,763
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	1,950,000
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,500,000	$E$22>=$E$27	Not Binding	1,500,000
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	216,941
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	740,361
$I$22	Upper Bound Naphtha	2,100,868	$I$22>=$I$27	Not Binding	777,862
$J$22	Upper Bound Imported	450,000	$J$22>=$J$27	Not Binding	450,000
$K$22	Upper Bound Imported	350,000	$K$22>=$K$27	Not Binding	350,000
$L$22	Upper Bound Alky-Poly	1,532,486	$L$22>=$L$27	Not Binding	1,108,589
$M$22	Upper Bound ETOH	7,339	$M$22>=$M$27	Not Binding	7,339
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Not Binding	402,975
$O$22	Upper Bound Imported	375,000	$O$22>=$O$27	Not Binding	375,000
$P$22	Upper Bound ETBE	72,279	$P$22>=$P$27	Not Binding	72,279
$Q$22	Upper Bound N-butane	250,000	$Q$22>=$Q$27	Not Binding	61,861
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	66,866
$S$22	Upper Bound & Cnap	217382	$S$22>=$S$27	Not Binding	217382

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/28/92 14:26

Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$27	Variables Full	150000	0	31.21267899	1E+30	1.657731184
$D$27	Variables Heavy	150000	0	34.33394689	1E+30	2.300749852
$E$27	Variables "LITE"	1500000	0	29.72636094	1.067981009	1E+30
$F$27	Variables Full	766530	0	30.02279394	0.209371427	0.222900305
$G$27	Variables Light	250000	0	30.52279394	1E+30	0.317450671
$H$27	Variables Heavy	857680	0	29.57245203	0.544839683	0.615397214
$I$27	Variables Naphtha	661503	0	24.687	0.649300041	3.036348755
$J$27	Variables Imported	450000	0	31.454175	0.772069207	1E+30
$K$27	Variables Imported	350000	0	29.88146625	0.289383664	1E+30
$L$27	Variables Alky-Poly	1320538	0	30.687	1.312172427	1.725331517
$M$27	Variables ETOH	0	0	51.23913288	1E+30	19.69556102
$N$27	Variables MTBE	402975	0	36.96	1.353154226	1E+30
$O$27	Variables Imported	375000	0	38.21	1.001592981	1E+30
$P$27	Variables ETBE	72279	0	38.808	1.027594709	1E+30
$Q$27	Variables N-butane	155931	0	18.51525	8.124769254	5.656678898
$R$27	Variables Xylene	70933	0	30.17225636	2.055402513	12.5046756
$S$27	Variables & Cnap	217382	0	24.069825	5.159869624	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$V$7	> Level	7,750,750	-35	0	17981.79796	129743.9762
$W$8	< Current Level	7,750,750	0	9688437.5	1E+30	1937687.5
$W$9	< Current Level	3,284,181	0	5400000	1E+30	2115819.057
$W$10	< Current Level	2,136,093	0	4000000	1E+30	1863907.076
$W$11	< Current Level	701,849	0	787346.6895	1E+30	85498.18813
$W$12	< Current Level	1,937,688	-5	1937687.5	30605.88103	17665.99624
$W$13	> Current Level	168,939	0	84812.4576	84126.78152	1E+30
$W$14	> Current Level	669,683,453	0	0	18139630.8	1E+30
$W$15	> Current Level	736,321,250	0	0	964407.9468	2576431.236
$W$16	< Current Level	65,881,375	0	65881375	948771.9072	7066842.274
$W$17	< Current Level	1,885,427	-1	1885427.124	39272.32622	224653.2887
$W$18	< Current Level	77,507	-63	77507.5	221.6823395	3866.597068
$W$19	< Current Level	30,694	0	48923.67906	1E+30	18229.8947
$C$21	Lower Bound Full	150,000	-2	0	97528.16763	30676.80408
$D$21	Lower Bound Heavy	150,000	-2	0	81435.00304	350000
$E$21	Lower Bound "LITE"	250,000	0	0	1E+30	1250000
$F$21	Lower Bound Full	500,000	0	0	1E+30	266529.6143
$G$21	Lower Bound Light	250,000	0	0	648638.0933	175786.9514
$H$21	Lower Bound Heavy	250,000	0	0	1E+30	607680.477
$I$21	Lower Bound Naphtha	125,000	0	0	1E+30	536502.7986

$J$21	Lower Bound Imported	0	0	0	1E+30	450000
$K$21	Lower Bound Imported	0	0	0	1E+30	350000
$L$21	Lower Bound Alky-Poly	625,000	0	0	1E+30	695537.8307
$M$21	Lower Bound ETOH	0	-20	0	142321.2599	7338.552044
$N$21	Lower Bound MTBE	0	0	0	1E+30	402975
$O$21	Lower Bound Imported	0	0	0	1E+30	375000
$P$21	Lower Bound ETBE	0	0	0	1E+30	72278.91156
$Q$21	Lower Bound N-butane	0	0	0	1E+30	155930.532
$R$21	Lower Bound Xylene	0	0	0	1E+30	70933.2096
$S$21	Lower Bound & Cnap	0	0	0	1E+30	217381.6262
$C$22	Upper Bound Full	2,250,000	0	0	2100000	1E+30
$D$22	Upper Bound Heavy	500,000	0	0	350000	1E+30
$E$22	Upper Bound "LITE"	1,500,000	1	0	276865.5597	30157.0729
$F$22	Upper Bound Full	1,750,000	0	0	983470.3857	1E+30
$G$22	Upper Bound Light	800,000	0	0	550000	1E+30
$H$22	Upper Bound Heavy	975,000	0	0	117319.523	1E+30
$I$22	Upper Bound Naphtha	2,100,868	0	0	1439364.939	1E+30
$J$22	Upper Bound Imported	450,000	1	0	232067.2527	26777.73884
$K$22	Upper Bound Imported	350,000	0	0	342065.0411	28885.1523
$L$22	Upper Bound Alky-Poly	1,532,486	0	0	211948.4193	1E+30
$M$22	Upper Bound ETOH	7,339	0	0	7338.551859	1E+30
$N$22	Upper Bound MTBE	402,975	1	0	125462.1074	87333.54241
$O$22	Upper Bound Imported	375,000	1	0	87142.24432	40685.61058
$P$22	Upper Bound ETBE	72,279	1	0	72278.91156	42928.46171
$Q$22	Upper Bound N-butane	250,000	0	0	94069.46799	1E+30
$R$22	Upper Bound Xylene	75,000	0	0	4066.790404	1E+30
$S$22	Upper Bound & Cnap	217382	5	0	53408.77328	130689.563

Catalytic Cracking and Hydrocracking

	FCCU - VGO			FCCU - HGO		Hydrocracker - VGO		r		- HGO
	Dist	Mogas	Hi-Sev	Dist	Mogas	Hi-Sev	Dist	Nap	RES	Dist
	9.25	8.66	6.90	9.41	8.96	7.18	16.49	9.04	7.39	16.86
Naphtha	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.08	0.10	0.15
LCO	0.54	0.21	0.16	0.54	0.21	0.16	-0.25	-0.25	0.00	-0.25
Distillate	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.65	0.94
C4	0.12	0.17	0.22	0.12	0.17	0.22	0.03	0.21	0.03	0.03
FCCN	0.32	0.59	0.55	0.32	0.59	0.55	0.00	0.00	0.00	0.00
FCCU Cap	1	1	1	1	1	1	0	0	0	0
H-C Cap	0	0	0	0	0	0	1	1	1	1
HOC Cap	0	0	0	0	0	0	0	0	0	0
H-Oil Feed	0	0	0	0	0	0	0	0	0	0
Ares Feed	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	0.000	0.000	-0.800	0.000
VRES Feed	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.250	-0.250	-0.200	0.000
VGO Feed	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750	-0.750	0.000	0.000
HGO Feed	0.000	0.000	0.000	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750
LB	0	0	0	0	0	0	50000	0	50000	50000
UB	810000	2700000	1782000	810000	1350000	810000	345431	115144	230288	92115
Solution	810000	109159	1782000	406845	0	810000	50000	77603	190857	50000

$34,961,870

Output	b/d
Naphtha	217382
Light Hydrocrackate	108691
LCO	1027310
Distillate	218057
Butane & C4	789396
FCCN	1874210
Ares	-936286
Vres	-657773

Capacity Utilization	
FCCU	72.56%
Hydrocracker	100.00%
HOC	0.00%

No ETOH in Gasoline Supply

Summer Gasoline Blend

Distillation Model

Nap	HOC Nap	HOC Dist		Constraint
8.67	10.64	11.68		Constraint
1.08	0.12	0.07	>	217,382
-0.25	0.00	0.00	>	250,000
0.00	0:23	0.47	>	218,057
0.21	0.17	0.08	>	767,924
0.00	0.48	0.35	>	1,874,210
0	0.00	0.00	<	5,400,000
1	0.00	0.00	<	460,575
0	1.00	1.00	<	225,000
0	-0.750	-0.750	>	-112,500
0.000	0.000	0.000	>	-996,782
0.000	-0.250	-0.250	>	-789,840
0.000	0.000	0.000	>	-2,056,086
-0.750	0.000	0.000	>	-2,523,662
0	0	0		
92115	168750	112500		9,418,343
92115	0	0		4,378,579

No ETOH in Gasoline Supply

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/28/92 14:28

Target Cell (Min)

Cell	Name	Original Value	Final Value
$A$55	Solution	$34,961,874	$34,961,870

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$54	Solution Dist	810000	810000
$D$54	Solution Mogas	109159	109159
$E$54	Solution Hi-Sev	1782000	1782000
$F$54	Solution Dist	406844	406845
$G$54	Solution Mogas	0	0
$H$54	Solution Hi-Sev	810000	810000
$I$54	Solution Dist	50000	50000
$J$54	Solution Nap	77603	77603
$K$54	Solution RES	190857	190857
$L$54	Solution Dist	50000	50000
$M$54	Solution Nap	92115	92115
$N$54	Solution Nap	0	0
$O$54	Solution Dist	0	0

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$U$37	Naphtha Calculated Level	217,382	$U$37>=$Q$37	Binding	0
$U$38	LCO Calculated Level	1,027,310	$U$38>=$Q$38	Not Binding	777,310
$U$39	Distillate & Jet Calculated Level	218,057	$U$39>=$Q$39	Not Binding	218,057
$U$40	Butane & C4 Calculated Level	789,396	$U$40>=$Q$40	Not Binding	21,472
$U$41	FCCN Calculated Level	1,874,210	$U$41>=$Q$41	Binding	0
$U$42	FCCU Cap Calculated Level	3,918,004	$U$42<=$Q$42	Not Binding	1,481,996
$U$43	H-C Cap Calculated Level	460,575	$U$43<=$Q$43	Binding	0
$U$44	HOC Cap Calculated Level	0	$U$44<=$Q$44	Not Binding	225,000
$U$45	H-Oil Feed Calculated Level	0	$U$45>=$Q$45	Not Binding	112,500
$U$46	Ares Feed Calculated Level	-936,286	$U$46>=$Q$46	Not Binding	60,496
$U$47	VRES Feed Calculated Level	-657,773	$U$47>=$Q$47	Not Binding	132,067
$U$48	VGO Feed Calculated Level	-1,851,456	$U$48>=$Q$48	Not Binding	204,630
$U$49	HGO Feed Calculated Level	-897,535	$U$49>=$Q$49	Not Binding	1,626,127
$C$52	UB Dist	810000	$C$52>=$C$54	Not Binding	810000
$D$52	UB Mogas	2700000	$D$52>=$D$54	Not Binding	2481682
$E$52	UB Hi-Sev	1782000	$E$52>=$E$54	Not Binding	1782000
$F$52	UB Dist	810000	$F$52>=$F$54	Not Binding	3689
$G$52	UB Mogas	1350000	$G$52>=$G$54	Not Binding	1350000
$H$52	UB Hi-Sev	810000	$H$52>=$H$54	Not Binding	810000
$I$52	UB Dist	345431	$I$52>=$I$54	Not Binding	245431

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/28/92 14:28

Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$54	Solution Dist	810000	0	9.253540061	0.16	1E+30
$D$54	Solution Mogas	109159	0	8.664047425	0.294962495	0.496182703
$E$54	Solution Hi-Sev	1782000	0	6.902483079	0.756998533	1E+30
$F$54	Solution Dist	406845	0	9.413540061	1.963737252	0.16
$G$54	Solution Mogas	0	0	8.959025145	1E+30	0.294961791
$H$54	Solution Hi-Sev	810000	0	7.176483079	0.482998533	1E+30
$I$54	Solution Dist	50000	8	16.49206725	1E+30	8.070345279
$J$54	Solution Nap	77603	0	9.039073499	12.38052352	0.365849999
$K$54	Solution RES	190857	0	7.38682125	0.897851446	12.38052352
$L$54	Solution Dist	50000	8	16.85791725	1E+30	8.436195279
$M$54	Solution Nap	92115	0	8.6732235	0.365849999	1E+30
$N$54	Solution Nap	0	2	10.6407702	1E+30	1.515982985
$O$54	Solution Dist	0	2	11.6789341	1E+30	1.888191367

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$U$37	Naphtha Calculated Level	217,382	12	217381.6262	36789.44878	38642.37622
$U$38	LCO Calculated Level	1,027,310	0	250000	777309.8771	1E+30
$U$39	Distillate & Jet Calculated I	218,057	11	0	85758.02794	173357.1975
$U$40	Butane & C4 Calculated L(	789,396	0	767924.1501	21471.7249	1E+30
$U$41	FCCN Calculated Level	1,874,210	11	1874210.091	146563.7254	50819.57211
$U$42	FCCU Cap Calculated Lev	3,918,004	0	5400000	1E+30	1481996.359
$U$43	H-C Cap Calculated Level	460,575	-1	460575	35779.97798	115602.2935
$U$44	HOC Cap Calculated Leve	0	0	225000	1E+30	225000
$U$45	H-Oil Feed Calculated Lev	0	0	-112500	112500	1E+30
$U$46	Ares Feed Calculated Lev(	-936,286	0	-996781.5	60495.56864	1E+30
$U$47	VRES Feed Calculated Le	-657,773	0	-789840.1139	132067.3929	1E+30
$U$48	VGO Feed Calculated Lev	-1,851,456	0	-2056085.508	204629.545	1E+30
$U$49	HGO Feed Calculated Lev	-897,535	0	-2523662	1626126.724	1E+30
$C$52	UB Dist	810000	0	0	403155.3441	314814.6846
$D$52	UB Mogas	2700000	0	0	2590841.015	1E+30
$E$52	UB Hi-Sev	1782000	1	0	323168.0117	112138.6439
$F$52	UB Dist	810000	0	0	403155.3441	1E+30
$G$52	UB Mogas	1350000	0	0	1350000	1E+30
$H$52	UB Hi-Sev	810000	0	0	323168.0117	112138.6439
$I$52	UB Dist	345431	0	0	295431.25	1E+30
$J$52	UB Nap	115144	0	0	37540.25386	1E+30
$K$52	UB RES	230288	0	0	39430.99614	1E+30
$L$52	UB Dist	92115	0	0	42115	1E+30
$M$52	UB Nap	92115	0	0	37540.25386	77603.49614

$J$52	UB Nap	115144	$J$52>=$J$54	Not Binding	40063
$K$52	UB RES	230288	$K$52>=$K$54	Not Binding	151426
$L$52	UB Dist	92115	$L$52>=$L$54	Not Binding	7885
$M$52	UB Nap	92115	$M$52>=$M$54	Not Binding	92115
$N$52	UB Nap	168750	$N$52>=$N$54	Not Binding	168750
$O$52	UB Dist	112500	$O$52>=$O$54	Not Binding	112500
$C$54	Solution Dist	810000	$C$54>=$C$51	Not Binding	810000
$D$54	Solution Mogas	109159	$D$54>=$D$51	Not Binding	109159
$E$54	Solution Hi-Sev	1782000	$E$54>=$E$51	Not Binding	1782000
$F$54	Solution Dist	406845	$F$54>=$F$51	Not Binding	406845
$G$54	Solution Mogas	0	$G$54>=$G$51	Binding	0
$H$54	Solution Hi-Sev	810000	$H$54>=$H$51	Not Binding	810000
$I$54	Solution Dist	50000	$I$54>=$I$51	Binding	0
$J$54	Solution Nap	77603	$J$54>=$J$51	Not Binding	77603
$K$54	Solution RES	190857	$K$54>=$K$51	Not Binding	140857
$L$54	Solution Dist	50000	$L$54>=$L$51	Binding	0
$M$54	Solution Nap	92115	$M$54>=$M$51	Not Binding	92115
$N$54	Solution Nap	0	$N$54>=$N$51	Binding	0
$O$54	Solution Dist	0	$O$54>=$O$51	Binding	0

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/28/92 14:28

Changing Cells

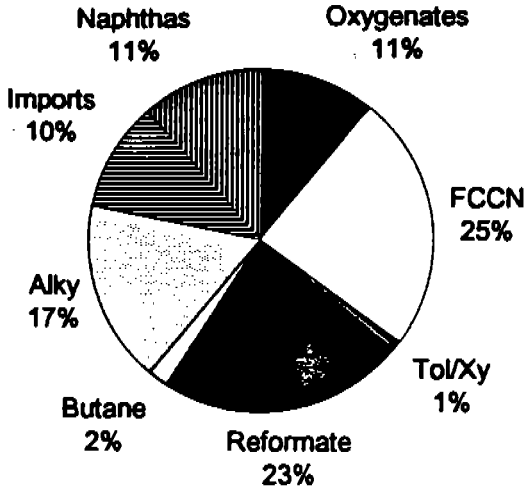
Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$54	Solution Dist	810000	0	9.253540061	0.16	1E+30
$D$54	Solution Mogas	109159	0	8.664047425	0.294962495	0.496182703
$E$54	Solution Hi-Sev	1782000	0	6.902483079	0.756998533	1E+30
$F$54	Solution Dist	406845	0	9.413540061	1.963737252	0.16
$G$54	Solution Mogas	0	0	8.959025145	1E+30	0.294961791
$H$54	Solution Hi-Sev	810000	0	7.176483079	0.482998533	1E+30
$I$54	Solution Dist	50000	8	16.49206725	1E+30	8.070345279
$J$54	Solution Nap	77603	0	9.039073499	12.38052352	0.365849999
$K$54	Solution RES	190857	0	7.38682125	0.897851446	12.38052352
$L$54	Solution Dist	50000	8	16.85791725	1E+30	8.436195279
$M$54	Solution Nap	92115	0	8.6732235	0.365849999	1E+30
$N$54	Solution Nap	0	2	10.6407702	1E+30	1.515982985
$O$54	Solution Dist	0	2	11.6789341	1E+30	1.888191367

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$U$37	Naphtha Calculated Level	217,382	12	217381.6262	36789.44878	38642.37622
$U$38	LCO Calculated Level	1,027,310	0	250000	777309.8771	1E+30
$U$39	Distillate & Jet Calculated I	218,057	11	0	85758.02794	173357.1975
$U$40	Butane & C4 Calculated L(	789,396	0	767924.1501	21471.7249	1E+30
$U$41	FCCN Calculated Level	1,874,210	11	1874210.091	146563.7254	50819.57211
$U$42	FCCU Cap Calculated Lev	3,918,004	0	5400000	1E+30	1481996.359
$U$43	H-C Cap Calculated Level	460,575	-1	460575	35779.97798	115602.2935
$U$44	HOC Cap Calculated Leve	0	0	225000	1E+30	225000
$U$45	H-Oil Feed Calculated Lev	0	0	-112500	112500	1E+30
$U$46	Ares Feed Calculated Lev(	-936,286	0	-996781.5	60495.56864	1E+30
$U$47	VRES Feed Calculated Le	-657,773	0	-789840.1139	132067.3929	1E+30
$U$48	VGO Feed Calculated Lev	-1,851,456	0	-2056085.508	204629.545	1E+30
$U$49	HGO Feed Calculated Lev	-897,535	0	-2523662	1626126.724	1E+30
$C$52	UB Dist	810000	0	0	403155.3441	314814.6846
$D$52	UB Mogas	2700000	0	0	2590841.015	1E+30
$E$52	UB Hi-Sev	1782000	1	0	323168.0117	112138.6439
$F$52	UB Dist	810000	0	0	403155.3441	1E+30
$G$52	UB Mogas	1350000	0	0	1350000	1E+30
$H$52	UB Hi-Sev	810000	0	0	323168.0117	112138.6439
$I$52	UB Dist	345431	0	0	295431.25	1E+30
$J$52	UB Nap	115144	0	0	37540.25386	1E+30
$K$52	UB RES	230288	0	0	39430.99614	1E+30
$L$52	UB Dist	92115	0	0	42115	1E+30
$M$52	UB Nap	92115	0	0	37540.25386	77603.49614

$N$52	UB Nap	168750	0	0	168750	1E+30
$O$52	UB Dist	112500	0	0	112500	1E+30

Gasoline Composition



30.17 24.07

Toluene/ Xylene	Isomerate & Cnap	<,>,=	Level	Current Level	Constraint In Units/bbl	Constraint
60792	217382	>	7,210,000	7,210,000	7210000	Volume: LB
60792	217382	<	9,012,500	7,210,000	9012500	Volume: UB
0	0	<	5,400,000	1,807,450	5400000	FCCN
0	0	<	4,000,000	3,378,199	4000000	Reformate
0	1522	<	1,081,500	468,550	0.150	Olefins
57934	3043	<	2,523,500	2,189,082	0.350	Aromatics
0	0	>	145,726	145,726	0.020	Oxygen
6133863	18042675	>	606,120,822	621,627,735	84.067	MON
6705303	19564346	>	684,950,000	684,950,000	95.000	RON
72950	2608580	<	75,705,000	75,306,546	10.500	RVP: Max
0	0	<	1,698,733	1,085,559	1698733	Light Olefin Feed
4559	3261	<	72,100	72,100	0.010	Benzene
0	0	<	48,924	30,694	7.500E-01	ETOH Prod.
0	0		2300000	Lower Bound Total		
75,000	217382		13008328	Upper Bound Total		

		Total Mogas (b/d)	Average Cost ($/bbl)
60792	217382	7,210,000	$29.99
			Average cost ($/gal)
			$0.714
			Total ETOH Used
			0
			Average Cost of Motor Fuel ($/bbl)
			$29.99

Subtotal		
7,210,000		
100.00%		Final
		Octane
110	90	95
101	83	84

$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	500,000
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	250,000
$I$21	Lower Bound Naphtha	125,000	$I$21<=$I$27	Not Binding	1,610,704
$J$21	Lower Bound Imported	0	$J$21<=$J$27	Not Binding	500,000
$K$21	Lower Bound Imported	0	$K$21<=$K$27	Not Binding	900,000
$L$21	Lower Bound Alky-Poly	625,000	$L$21<=$L$27	Not Binding	625,000
$M$21	Lower Bound ETOH	0	$M$21<=$M$27	Binding	0
$N$21	Lower Bound MTBE	0	$N$21<=$N$27	Not Binding	805,950
$O$21	Lower Bound Imported	0	$O$21<=$O$27	Not Binding	510,015
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Not Binding	144,558
$Q$21	Lower Bound N-butane	0	$Q$21<=$Q$27	Not Binding	500,000
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Not Binding	121,583
$S$21	Lower Bound & Cnap	0	$S$21<=$S$27	Not Binding	434,763
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	967,427
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,000,000	$E$22>=$E$27	Not Binding	1,000,000
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	750,000
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	475,000
$I$22	Upper Bound Naphtha	2,100,868	$I$22>=$I$27	Not Binding	365,164
$J$22	Upper Bound Imported	250,000	$J$22>=$J$27	Not Binding	250,000
$K$22	Upper Bound Imported	450,000	$K$22>=$K$27	Not Binding	450,000
$L$22	Upper Bound Alky-Poly	1,532,486	$L$22>=$L$27	Not Binding	282,486
$M$22	Upper Bound ETOH	7,339	$M$22>=$M$27	Not Binding	7,339
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Not Binding	402,975
$O$22	Upper Bound Imported	375,000	$O$22>=$O$27	Not Binding	135,015
$P$22	Upper Bound ETBE	72,279	$P$22>=$P$27	Not Binding	72,279
$Q$22	Upper Bound N-butane	250,000	$Q$22>=$Q$27	Not Binding	250,000
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	46,583
$S$22	Upper Bound & Cnap	217382	$S$22>=$S$27	Not Binding	217382

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/28/92 12:41

Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$27	Variables Full	1608713	0	31.21267899	0.378815725	0.050198574
$D$27	Variables Heavy	150000	0	34.33394689	1E+30	1.848501527
$E$27	Variables "LITE"	1000000	0	29.72636094	0.923036874	1E+30
$F$27	Variables Full	500000	0	30.02279394	1E+30	0.679091917
$G$27	Variables Light	250000	0	30.52279394	1E+30	0.870943472
$H$27	Variables Heavy	250000	0	29.57245203	1E+30	0.627189494
$I$27	Variables Naphtha	867852	0	24.687	0.084633644	0.41012329
$J$27	Variables Imported	250000	0	31.454175	0.173342586	1E+30
$K$27	Variables Imported	450000	0	29.88146625	0.127183083	1E+30
$L$27	Variables Alky-Poly	625000	0	30.687	1E+30	0.355793775
$M$27	Variables ETOH	0	0	51.24002695	1E+30	14.64410889
$N$27	Variables MTBE	402975	0	36.96	1.5	1E+30
$O$27	Variables Imported	255008	0	38.46	7.83890605	0.020382789
$P$27	Variables ETBE	72279	0	38.808	0.017582956	1E+30
$Q$27	Variables N-butane	250000	0	18.51525	12.43225312	1E+30
$R$27	Variables Xylene	60792	0	30.17225636	3.413068081	4.024917076
$S$27	Variables & Cnap	217382	0	24.069825	4.702001337	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$V$7	> Level	7,210,000	-31	0	90893.03121	34830.00656
$W$8	< Current Level	7,210,000	0	9012500	1E+30	1802500
$W$9	< Current Level	1,807,450	0	5400000	1E+30	3592549.747
$W$10	< Current Level	3,378,199	0	4000000	1E+30	621801.3737
$W$11	< Current Level	468,550	0	1081500	1E+30	612949.5555
$W$12	< Current Level	2,189,082	0	2523500	1E+30	334418.2105
$W$13	> Current Level	145,726	7	145725.636	21838.60311	46246.29519
$W$14	> Current Level	621,627,735	0	0	15506913.2	1E+30
$W$15	> Current Level	684,950,000	0	0	4371954.801	3523115.215
$W$16	< Current Level	75,306,546	0	75705000	1E+30	398454.3695
$W$17	< Current Level	1,085,559	0	1698721.135	1E+30	613162.5159
$W$18	< Current Level	72,100	-69	72100	962.985639	3511.812829
$W$19	< Current Level	30,694	0	48923.67906	1E+30	18229.8947
$C$21	Lower Bound Full	150,000	0	0	1E+30	1458713.265
$D$21	Lower Bound Heavy	150,000	-2	0	74462.29921	350000
$E$21	Lower Bound "LITE"	250,000	0	0	1E+30	750000
$F$21	Lower Bound Full	500,000	-1	0	134338.9136	1093891.532
$G$21	Lower Bound Light	250,000	-1	0	677194.2712	550000
$H$21	Lower Bound Heavy	250,000	-1	0	57568.86393	472362.2525
$I$21	Lower Bound Naphtha	125,000	0	0	1E+30	742852.02

$J$21	Lower Bound Imported	0	0	0	1E+30	250000
$K$21	Lower Bound Imported	0	0	0	1E+30	450000
$L$21	Lower Bound Alky-Poly	625,000	0	0	111417.0259	160733.6324
$M$21	Lower Bound ETOH	0	-15	0	64231.19136	7338.551844
$N$21	Lower Bound MTBE	0	0	0	1E+30	402975
$O$21	Lower Bound Imported	0	0	0	1E+30	255007.6752
$P$21	Lower Bound ETBE	0	0	0	1E+30	72278.91156
$Q$21	Lower Bound N-butane	0	0	0	1E+30	250000
$R$21	Lower Bound Xylene	0	0	0	1E+30	60791.50211
$S$21	Lower Bound & Cnap	0	0	0	1E+30	217381.6262
$C$22	Upper Bound Full	2,250,000	0	0	641286.7351	1E+30
$D$22	Upper Bound Heavy	500,000	0	0	350000	1E+30
$E$22	Upper Bound "LITE"	1,000,000	1	0	153901.8999	311171.1602
$F$22	Upper Bound Full	1,750,000	0	0	1250000	1E+30
$G$22	Upper Bound Light	800,000	0	0	550000	1E+30
$H$22	Upper Bound Heavy	975,000	0	0	725000	1E+30
$I$22	Upper Bound Naphtha	2,100,868	0	0	1233015.717	1E+30
$J$22	Upper Bound Imported	250,000	0	0	250000	558833.9881
$K$22	Upper Bound Imported	450,000	0	0	450000	636210.5207
$L$22	Upper Bound Alky-Poly	1,532,486	0	0	907486.25	1E+30
$M$22	Upper Bound ETOH	7,339	0	0	7338.551859	1E+30
$N$22	Upper Bound MTBE	402,975	2	0	119992.3248	255007.6752
$O$22	Upper Bound Imported	375,000	0	0	119992.3248	1E+30
$P$22	Upper Bound ETBE	72,279	0	0	72278.91156	42928.46171
$Q$22	Upper Bound N-butane	250,000	12	0	250000	9166.287332
$R$22	Upper Bound Xylene	75,000	0	0	14208.49789	1E+30
$S$22	Upper Bound & Cnap	217382	5	0	217381.6262	234874.3477

Catalytic Cracking and Hydrocracking

Distillation Model

	FCCU - VGO			FCCU - HGO		Hydrocracker - VGO		r		- HGO
	Dist	Mogas	Hi-Sev	Dist	Mogas	Hi-Sev	Dist	Nap	RES	Dist
	9.25	8.66	6.90	9.41	8.96	7.18	16.49	9.04	7.39	16.86
Naphtha	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.08	0.10	0.15
LCO	0.54	0.21	0.16	0.54	0.21	0.16	-0.25	-0.25	0.00	-0.25
Distillate	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.65	0.94
C4	0.12	0.17	0.22	0.12	0.17	0.22	0.03	0.21	0.03	0.03
FCCN	0.32	0.59	0.55	0.32	0.59	0.55	0.00	0.00	0.00	0.00
FCCU Cap	1	1	1	1	1	1	0	0	0	0
H-C Cap	0	0	0	0	0	0	1	1	1	1
HOC Cap	0	0	0	0	0	0	0	0	0	0
H-Oil Feed	0	0	0	0	0	0	0	0	0	0
Ares Feed	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	0.000	0.000	-0.800	0.000
VRES Feed	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.250	-0.250	-0.200	0.000
VGO Feed	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750	-0.750	0.000	0.000
HGO Feed	0.000	0.000	0.000	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750
LB	0	0	0	0	0	0	50000	0	50000	50000
UB	810000	2700000	1782000	810000	1350000	810000	345431	115144	230288	92115
Solution	810000	354483	453958	810000	0	0	50000	64976	203484	50000
$27,594,792										

Output

	b/d
Naphtha	217382
Light Hydrocrackate	108691
LCO	957602
Distillate	287765
Butane & C4	414112
FCCN	1033689
Ares	-648475
Vres	-471207

Capacity Utilization

FCCU	44.97%
Hydrocracker	100.00%
HOC	66.67%

No ETOH in Gasoline Supply

Distillation Model

Nap	HOC Nap	HOC Dist		Constraint
8.67	10.64	11.68		
1.08	0.12	0.07	>	217,382
-0.25	0.00	0.00	>	250,000
0.00	0.23	0.47	>	287,765
0.21	0.17	0.08	>	393,639
0.00	0.48	0.35	>	1,000,000
0	0.00	0.00	<	5,400,000
1	0.00	0.00	<	460,575
0	1.00	1.00	<	225,000
0	-0.750	-0.750	>	-112,500
0.000	0.000	0.000	>	-996,782
0.000	-0.250	-0.250	>	-789,840
0.000	0.000	0.000	>	-2,056,086
-0.750	0.000	0.000	>	-2,523,662
0	0	0		
92115	168750	112500		9,418,343
92115	37500	112500		3,039,016

No ETOH In Gasoline Supply

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/28/92 12:07

Target Cell (Min)

Cell	Name	Original Value	Final Value
$A$55	Solution	$31,842,387	$27,594,792

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$54	Solution Dist	810000	810000
$D$54	Solution Mogas	1064792	354483
$E$54	Solution Hi-Sev	0	453958
$F$54	Solution Dist	810000	810000
$G$54	Solution Mogas	0	0
$H$54	Solution Hi-Sev	0	0
$I$54	Solution Dist	94804	50000
$J$54	Solution Nap	27912	64976
$K$54	Solution RES	287859	203484
$L$54	Solution Dist	50000	50000
$M$54	Solution Nap	115144	92115
$N$54	Solution Nap	37500	37500
$O$54	Solution Dist	112500	112500

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$U$37	Naphtha Calculated Level	217,382	$U$37>=$Q$37	Binding	0
$U$38	LCO Calculated Level	957,602	$U$38>=$Q$38	Not Binding	707,602
$U$39	Distillate & Jet Calculated Level	287,765	$U$39>=$Q$39	Not Binding	287,765
$U$40	Butane & C4 Calculated Level	414,112	$U$40>=$Q$40	Binding	0
$U$41	FCCN Calculated Level	1,033,689	$U$41>=$Q$41	Not Binding	33,689
$U$42	FCCU Cap Calculated Level	2,428,441	$U$42<=$Q$42	Not Binding	2,971,559
$U$43	H-C Cap Calculated Level	460,575	$U$43<=$Q$43	Binding	0
$U$44	HOC Cap Calculated Level	150,000	$U$44<=$Q$44	Not Binding	75,000
$U$45	H-Oil Feed Calculated Level	-112,500	$U$45>=$Q$45	Binding	0
$U$46	Ares Feed Calculated Level	-648,475	$U$46>=$Q$46	Not Binding	348,306
$U$47	VRES Feed Calculated Level	-471,207	$U$47>=$Q$47	Not Binding	318,633
$U$48	VGO Feed Calculated Level	-1,138,219	$U$48>=$Q$48	Not Binding	917,867
$U$49	HGO Feed Calculated Level	-633,086	$U$49>=$Q$49	Not Binding	1,890,576
$C$52	UB Dist	810000	$C$52>=$C$54	Not Binding	810000
$D$52	UB Mogas	2700000	$D$52>=$D$54	Not Binding	1991034
$E$52	UB Hi-Sev	1782000	$E$52>=$E$54	Not Binding	874083
$F$52	UB Dist	810000	$F$52>=$F$54	Not Binding	810000
$G$52	UB Mogas	1350000	$G$52>=$G$54	Not Binding	1350000
$H$52	UB Hi-Sev	810000	$H$52>=$H$54	Not Binding	810000
$I$52	UB Dist	345431	$I$52>=$I$54	Not Binding	245431

$J$52	UB Nap	115144	$J$52>=$J$54	Not Binding	14808
$K$52	UB RES	230288	$K$52>=$K$54	Not Binding	176681
$L$52	UB Dist	92115	$L$52>=$L$54	Not Binding	7885
$M$52	UB Nap	92115	$M$52>=$M$54	Not Binding	92115
$N$52	UB Nap	168750	$N$52>=$N$54	Not Binding	93750
$O$52	UB Dist	112500	$O$52>=$O$54	Not Binding	112500
$C$54	Solution Dist	810000	$C$54>=$C$51	Not Binding	810000
$D$54	Solution Mogas	354483	$D$54>=$D$51	Not Binding	354483
$E$54	Solution Hi-Sev	453958	$E$54>=$E$51	Not Binding	453958
$F$54	Solution Dist	810000	$F$54>=$F$51	Not Binding	810000
$G$54	Solution Mogas	0	$G$54>=$G$51	Binding	0
$H$54	Solution Hi-Sev	0	$H$54>=$H$51	Binding	0
$I$54	Solution Dist	50000	$I$54>=$I$51	Binding	0
$J$54	Solution Nap	64976	$J$54>=$J$51	Not Binding	64976
$K$54	Solution RES	203484	$K$54>=$K$51	Not Binding	153484
$L$54	Solution Dist	50000	$L$54>=$L$51	Binding	0
$M$54	Solution Nap	92115	$M$54>=$M$51	Not Binding	92115
$N$54	Solution Nap	37500	$N$54>=$N$51	Not Binding	37500
$O$54	Solution Dist	112500	$O$54>=$O$51	Not Binding	112500

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/28/92 12:08

Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$54	Solution Dist	810000	0	9.253540061	11.98075354	1E+30
$D$54	Solution Mogas	354483	0	8.664047425	0.294999999	1.169329632
$E$54	Solution Hi-Sev	453958	0	6.902483079	0.273999999	0.301304089
$F$54	Solution Dist	810000	0	9.413540061	11.82075354	1E+30
$G$54	Solution Mogas	0	0	8.959047425	1E+30	0.294999999
$H$54	Solution Hi-Sev	0	0	7.176483079	1E+30	0.273999999
$I$54	Solution Dist	50000	6	16.49206725	1E+30	5.722580472
$J$54	Solution Nap	64976	0	9.039073498	112.1625773	0.365849998
$K$54	Solution RES	203484	0	7.38682125	6.030246089	119.8654948
$L$54	Solution Dist	50000	6	16.85791725	1E+30	6.088430472
$M$54	Solution Nap	92115	0	8.6732235	0.365849998	1E+30
$N$54	Solution Nap	37500	0	10.64076834	3.167048524	6.11558647
$O$54	Solution Dist	112500	0	11.67891313	6.11558647	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$U$37	Naphtha Calculated Level	217,382	37	217381.6262	44650.31646	21336.02887
$U$38	LCO Calculated Level	957,602	0	250000	707601.9689	1E+30
$U$39	Distillate & Jet Calculated I	287,765	39	0	51518.98463	17349.32017
$U$40	Butane & C4 Calculated L(	414,112	3	414112.2525	43246.89848	31799.25685
$U$41	FCCN Calculated Level	1,033,689	0	1000000	33688.96679	1E+30
$U$42	FCCU Cap Calculated Lev	2,428,441	0	5400000	1E+30	2971558.959
$U$43	H-C Cap Calculated Level	460,575	-21	460575	23289.10402	70107.2113
$U$44	HOC Cap Calculated Leve	150,000	0	225000	1E+30	75000
$U$45	H-Oil Feed Calculated Lev	-112,500	4	-112500	28125	56250
$U$46	Ares Feed Calculated Lev(	-648,475	0	-996781.5	348306.048	1E+30
$U$47	VRES Feed Calculated Le	-471,207	0	-789840.1139	318633.1605	1E+30
$U$48	VGO Feed Calculated Lev	-1,138,219	0	-2056085.508	917866.8724	1E+30
$U$49	HGO Feed Calculated Lev	-633,086	0	-2523662	1890575.75	1E+30
$C$52	UB Dist	810000	12	0	130928.8617	39369.84126
$D$52	UB Mogas	2700000	0	0	2345517.226	1E+30
$E$52	UB Hi-Sev	1782000	0	0	1328041.734	1E+30
$F$52	UB Dist	810000	12	0	130928.8617	39369.84126
$G$52	UB Mogas	1350000	0	0	1350000	1E+30
$H$52	UB Hi-Sev	810000	0	0	810000	1E+30
$I$52	UB Dist	345431	0	0	295431.25	1E+30
$J$52	UB Nap	115144	0	0	50167.80488	1E+30
$K$52	UB RES	230288	0	0	26803.44512	1E+30
$L$52	UB Dist	92115	0	0	42115	1E+30
$M$52	UB Nap	92115	0	0	50167.80488	64975.94512

$N$52 UB Nap	168750	0	0	131250	1E+30
$O$52 UB Dist	112500	6	0	112500	37500

Summer Gasoline Blend — Ten Percent ETOH — Current Environmental Standards

Obj. F'n. Values ($/bbl)	31.20	34.33	29.72	30.01	30.51	29.56	24.69	31.45	29.88	30.69	51.24	36.96	38.46	38.81	18.52
				Variables											
Constraint	Reformate Full	Reformate Heavy	Reformate "LITE"	FCCN Full	FCCN Light	FCCN Heavy	SR Naphtha	IG-1 Imported	IG-2 Imported	Alky-Poly	ETOH	MTBE	MTBE Imported	ETBE	N-butane
Volume: LB	150000	150000	1000000	500000	250000	975000	530294	882571	0	1532486	0	402975	178684	72279	116726
Volume: UB	150000	150000	1000000	500000	250000	975000	530294	882571	0	1532486	0	402975	178684	72279	116726
FCCN	0	0	0	909091	490196	1591837	0	0	0	0	0	0	0	0	0
Reformate	185185	230769	1136364	0	0	0	0	0	0	0	0	0	0	0	11873
Olefins	1050	750	50000	145500	99500	160875	7954	68257	0	76624	0	0	0	0	0
Aromatics	93900	130800	350000	146000	33750	587925	37121	242707	0	61299	0	0	0	0	3152
Oxygen	0	0	0	0	0	0	0	23829	0	0	0	73341	32520	11348	0
MON	13110000	14175000	85000000	40350000	20200000	79267500	38711441	76783706	0	139609497	0	41103450	18225758	7444728	10458689
RON	14655000	15735000	95000000	46050000	23150000	89602500	39772029	86491990	0	142827719	0	47148075	20906017	8601190	10995631
RVP	1500000	405000	8000000	3550000	2475000	2535000	6383525	6825713	0	11493647	0	3143205	1393734	361395	6419954
Lt. Olefin Feed	0	0	0	0	0	0	0	0	0	1762359	0	317303	0	49506	0
Benzene	1500	3000	7500	7500	3125	19500	7954	6619	0	7662	0	0	0	0	0
Ethanol	0	0	0	0	0	0	0	0	0	0	0	0	0	30694	0
Lower Bound	150,000	150,000	250,000	500,000	250,000	250,000	125,000	0	0	625,000	0	0	0	0	0
Upper Bound	2,250,000	500,000	1,000,000	1,750,000	800,000	975,000	2,051,844	1,000,000	450,000	1,532,486	7,339	402,975	375,000	72,279	250,000
Objective Function		2.115E+08													
Variables	150000	150000	1000000	500000	250000	975000	530294	882571	0	1532486	0	402975	178684	72279	116726

Mixing Values	Benzene	Aromatics	Olefins	Oxygen	RVP		Oxygenate	FCCN	Tol/Xy	Reformate	Butane	Alky	Imports	Naphthas	
	1.00%	24.65%	9.06%	2.02%	8.45		653,936	1,725,000	31,262	1,300,000	116,726	1,532,486	882,571	733,691	
							9.37%	24.73%	0.45%	18.64%	1.67%	21.97%	12.65%	10.52%	
Octane Values															
RON	98	105	95	92	93	92	75	98	92	93	106	117	117	119	94
MON	87	95	85	81	81	81	73	87	84	91	89	102	102	103	90

30.16 24.07

Toluene/ Xylene	Isomerate & Cnap	<,>,=	Level	Current Level	Constraint in Units/bbl	Constraint
31262	203397	>	6,975,675	6,975,675	6975675	Volume: LB
31262	203397	<	8,719,594	6,975,675	8719594	Volume: UB
0	0	<	5,400,000	2,991,124	5400000	FCCN
0	0	<	4,000,000	1,563,991	4000000	Reformate
0	1424	<	1,046,351	631,935	0.150	Olefins
29793	2848	<	2,441,486	1,719,294	0.350	Aromatics
0	0	>	141,039	141,039	0.020	Oxygen
3154363	16881966	>	586,437,522	604,476,098	84.069	MON
3448229	18305746	>	662,689,125	662,689,125	95.000	RON
37515	2440766	<	58,944,454	58,944,454	8.450	RVP: Max
0	0	<	2,191,382	2,129,168	2191382	Light Olefin Feed
2345	3051	<	69,757	69,757	0.010	Benzene
0	0	<	46,924	30,694	7.500E-01	ETOH Prod.
0	0		2300000	Lower Bound Total		
75,000	203397		13695320	Upper Bound Total		

		Total Mogas (b/d)	Average Cost ($/bbl)
31262	203397	6,975,675	$30.31
			Average cost ($/gal)
			$0.722
			Total ETOH Used
			775,075
			Average Cost of Motor Fuel ($/bbl)
			$32.41

	Subtotal	
	6,975,675	
	100.00%	Final Octane
110	90	95
101	83	84

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/27/92 16:44

Target Cell (Min)

Cell	Name	Original Value	Final Value
$D$25	Objective Function Heavy	2.115E+08	2.115E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	150000	150000
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	1000000	1000000
$F$27	Variables Full	500000	500000
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	975000	975000
$I$27	Variables Naphtha	530294	530294
$J$27	Variables Imported	882571	882571
$K$27	Variables Imported	0	0
$L$27	Variables Alky-Poly	1532486	1532486
$M$27	Variables ETOH	0	0
$N$27	Variables MTBE	402975	402975
$O$27	Variables Imported	178684	178684
$P$27	Variables ETBE	72279	72279
$Q$27	Variables N-butane	116726	116726
$R$27	Variables Xylene	31262	31262
$S$27	Variables & Cnap	203397	203397

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	6,975,675	$V$7<=$W$7	Not Binding	6,975,675
$W$8	< Current Level	6,975,675	$W$8<=$V$8	Not Binding	1,743,919
$W$9	< Current Level	2,991,124	$W$9<=$V$9	Not Binding	2,408,876
$W$10	< Current Level	1,563,991	$W$10<=$V$10	Not Binding	2,436,009
$W$11	< Current Level	631,935	$W$11<=$V$11	Not Binding	414,417
$W$12	< Current Level	1,719,294	$W$12<=$V$12	Not Binding	722,192
$W$13	> Current Level	141,039	$W$13>=$V$13	Binding	0
$W$14	> Current Level	604,476,098	$W$14>=$V$14	Not Binding	568,398,945
$W$15	> Current Level	662,689,125	$W$15>=$V$15	Not Binding	662,689,125
$W$16	< Current Level	58,944,454	$W$16<=$V$16	Binding	0
$W$17	< Current Level	2,129,168	$W$17<=$V$17	Not Binding	62,214
$W$18	< Current Level	69,757	$W$18<=$V$18	Binding	0
$W$19	< Current Level	30,694	$W$19<=$V$19	Not Binding	18,230
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	150,000
$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	1,750,000

$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	500,000
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	1,700,000
$I$21	Lower Bound Naphtha	125,000	$I$21<=$I$27	Not Binding	935,587
$J$21	Lower Bound Imported	0	$J$21<=$J$27	Not Binding	1,765,143
$K$21	Lower Bound Imported	0	$K$21<=$K$27	Binding	0
$L$21	Lower Bound Alky-Poly	625,000	$L$21<=$L$27	Not Binding	2,439,973
$M$21	Lower Bound ETOH	0	$M$21<=$M$27	Binding	0
$N$21	Lower Bound MTBE	0	$N$21<=$N$27	Not Binding	805,950
$O$21	Lower Bound Imported	0	$O$21<=$O$27	Not Binding	357,368
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Not Binding	144,558
$Q$21	Lower Bound N-butane	0	$Q$21<=$Q$27	Not Binding	233,453
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Not Binding	62,525
$S$21	Lower Bound & Cnap	0	$S$21<=$S$27	Not Binding	406,794
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	1,950,000
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,000,000	$E$22>=$E$27	Not Binding	1,000,000
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	750,000
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	975,000
$I$22	Upper Bound Naphtha	2,051,844	$I$22>=$I$27	Not Binding	991,256
$J$22	Upper Bound Imported	1,000,000	$J$22>=$J$27	Not Binding	765,143
$K$22	Upper Bound Imported	450,000	$K$22>=$K$27	Not Binding	450,000
$L$22	Upper Bound Alky-Poly	1,532,486	$L$22>=$L$27	Not Binding	1,532,486
$M$22	Upper Bound ETOH	7,339	$M$22>=$M$27	Not Binding	7,339
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Not Binding	402,975
$O$22	Upper Bound Imported	375,000	$O$22>=$O$27	Not Binding	17,632
$P$22	Upper Bound ETBE	72,279	$P$22>=$P$27	Not Binding	72,279
$Q$22	Upper Bound N-butane	250,000	$Q$22>=$Q$27	Not Binding	16,547
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	12,475
$S$22	Upper Bound & Cnap	203397	$S$22>=$S$27	Not Binding	203397

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/27/92 16:44

Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$27	Variables Full	150000	0	31.204558	1E+30	0.285716204
$D$27	Variables Heavy	150000	0	34.3250138	1E+30	0.658808765
$E$27	Variables "LITE"	1000000	0	29.71862667	1.372780922	1E+30
$F$27	Variables Full	500000	0	30.0146047	1E+30	0.04083735
$G$27	Variables Light	250000	0	30.51460471	1E+30	0.971908068
$H$27	Variables Heavy	975000	0	29.56438563	1.14847802	1E+30
$I$27	Variables Naphtha	530294	0	24.687	0.218925948	1.354891304
$J$27	Variables Imported	882571	0	31.454175	0.042794443	0.275876357
$K$27	Variables Imported	0	0	29.87980843	1E+30	0.321037194
$L$27	Variables Alky-Poly	1532486	0	30.687	0.365404623	1E+30
$M$27	Variables ETOH	0	0	51.23913288	1E+30	18.17680041
$N$27	Variables MTBE	402975	0	36.96	1.499999999	1E+30
$O$27	Variables Imported	178684	0	38.46	1.859610998	0.288466244
$P$27	Variables ETBE	72279	0	38.808	0.675952863	1E+30
$Q$27	Variables N-butane	116726	0	18.51525	4.575129653	0.614080135
$R$27	Variables Xylene	31262	0	30.16440607	0.607100224	9.171111317
$S$27	Variables & Cnap	203397	0	24.069825	4.057027355	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$V$7	> Level	6,975,675	-34	0	281752.8618	64628.39662
$W$8	< Current Level	6,975,675	0	8719593.75	1E+30	1743918.75
$W$9	< Current Level	2,991,124	0	5400000	1E+30	2408876.278
$W$10	< Current Level	1,563,991	0	4000000	1E+30	2436009.304
$W$11	< Current Level	631,935	0	1046351.25	1E+30	414416.6187
$W$12	< Current Level	1,719,294	0	2441486.25	1E+30	722192.0054
$W$13	> Current Level	141,039	9	141039.136	25816.53895	8257.170713
$W$14	> Current Level	604,476,098	0	0	18038576.5	1E+30
$W$15	> Current Level	662,689,125	0	0	2523578.521	6564507.576
$W$16	< Current Level	58,944,454	0	58944453.75	5808160.6	3628910.413
$W$17	< Current Level	2,129,168	0	2191381.665	1E+30	62213.85823
$W$18	< Current Level	69,757	-94	69756.75	3040.436576	2173.202839
$W$19	< Current Level	30,694	0	48923.67906	1E+30	18229.8947
$C$21	Lower Bound Full	150,000	0	0	91241.09552	685750.5368
$D$21	Lower Bound Heavy	150,000	-1	0	76938.90308	166796.9711
$E$21	Lower Bound "LITE"	250,000	0	0	1E+30	750000
$F$21	Lower Bound Full	500,000	0	0	123056.3334	464754.2547
$G$21	Lower Bound Light	250,000	-1	0	121069.0414	550000
$H$21	Lower Bound Heavy	250,000	0	0	1E+30	725000
$I$21	Lower Bound Naphtha	125,000	0	0	1E+30	405293.7136

$J$21	Lower Bound Imported	0	0	0	1E+30	882571.328
$K$21	Lower Bound Imported	0	0	0	135964.2813	449999.1928
$L$21	Lower Bound Alky-Poly	625,000	0	0	1E+30	907486.25
$M$21	Lower Bound ETOH	0	-18	0	83527.89599	7338.552044
$N$21	Lower Bound MTBE	0	0	0	1E+30	402975
$O$21	Lower Bound Imported	0	0	0	1E+30	178683.9068
$P$21	Lower Bound ETBE	0	0	0	1E+30	72278.91156
$Q$21	Lower Bound N-butane	0	0	0	1E+30	116726.4385
$R$21	Lower Bound Xylene	0	0	0	1E+30	31262.27189
$S$21	Lower Bound & Cnap	0	0	0	1E+30	203397.1796
$C$22	Upper Bound Full	2,250,000	0	0	2100000	1E+30
$D$22	Upper Bound Heavy	500,000	0	0	350000	1E+30
$E$22	Upper Bound "LITE"	1,000,000	1	0	89701.911	674182.3218
$F$22	Upper Bound Full	1,750,000	0	0	1250000	1E+30
$G$22	Upper Bound Light	800,000	0	0	550000	1E+30
$H$22	Upper Bound Heavy	975,000	1	0	127008.8432	249643.2414
$I$22	Upper Bound Naphtha	2,051,844	0	0	1521550.199	1E+30
$J$22	Upper Bound Imported	1,000,000	0	0	117428.672	1E+30
$K$22	Upper Bound Imported	450,000	0	0	450000	1E+30
$L$22	Upper Bound Alky-Poly	1,532,486	0	0	88657.319	54099.00716
$M$22	Upper Bound ETOH	7,339	0	0	7338.551859	1E+30
$N$22	Upper Bound MTBE	402,975	1	0	196316.0932	79011.75798
$O$22	Upper Bound Imported	375,000	0	0	196316.0932	1E+30
$P$22	Upper Bound ETBE	72,279	1	0	72278.91156	42928.46171
$Q$22	Upper Bound N-butane	250,000	0	0	133273.5615	1E+30
$R$22	Upper Bound Xylene	75,000	0	0	43737.72811	1E+30
$S$22	Upper Bound & Cnap	203397	4	0	168238.568	437633.8383

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/27/92 15:45

Target Cell (Min)

Cell	Name	Original Value	Final Value
$A$55	Solution	$41,323,896	$41,323,898

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$54	Solution Dist	804324	804324
$D$54	Solution Mogas	353705	353704
$E$54	Solution Hi-Sev	1782000	1782000
$F$54	Solution Dist	810000	810000
$G$54	Solution Mogas	12948	12948
$H$54	Solution Hi-Sev	810000	810000
$I$54	Solution Dist	50000	50000
$J$54	Solution Nap	53020	53021
$K$54	Solution RES	50000	50000
$L$54	Solution Dist	50000	50000
$M$54	Solution Nap	100125	100125
$N$54	Solution Nap	150000	150000
$O$54	Solution Dist	0	0

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$U$37	Naphtha Calculated Level	203,397	$U$37>=$Q$37	Not Binding	114,389
$U$38	LCO Calculated Level	1,300,166	$U$38>=$Q$38	Not Binding	1,050,166
$U$39	Distillate & Jet Calculated Level	161,000	$U$39>=$Q$39	Not Binding	161,000
$U$40	Butane & C4 Calculated Level	899,664	$U$40>=$Q$40	Binding	0
$U$41	FCCN Calculated Level	2,225,325	$U$41>=$Q$41	Not Binding	500,325
$U$42	FCCU Cap Calculated Level	4,572,977	$U$42<=$Q$42	Not Binding	827,023
$U$43	H-C Cap Calculated Level	303,146	$U$43<=$Q$43	Not Binding	197,479
$U$44	HOC Cap Calculated Level	150,000	$U$44<=$Q$44	Not Binding	75,000
$U$45	H-Oil Feed Calculated Level	-112,500	$U$45>=$Q$45	Binding	0
$U$46	Ares Feed Calculated Level	-954,595	$U$46>=$Q$46	Binding	0
$U$47	VRES Feed Calculated Level	-759,202	$U$47>=$Q$47	Not Binding	1,527
$U$48	VGO Feed Calculated Level	-1,988,284	$U$48>=$Q$48	Binding	0
$U$49	HGO Feed Calculated Level	-1,174,010	$U$49>=$Q$49	Not Binding	1,232,139
$C$52	UB Dist	810000	$C$52>=$C$54	Not Binding	798648
$D$52	UB Mogas	2700000	$D$52>=$D$54	Not Binding	1992591
$E$52	UB Hi-Sev	1782000	$E$52>=$E$54	Not Binding	1782000
$F$52	UB Dist	810000	$F$52>=$F$54	Not Binding	810000
$G$52	UB Mogas	1350000	$G$52>=$G$54	Not Binding	1324103
$H$52	UB Hi-Sev	810000	$H$52>=$H$54	Not Binding	810000
$I$52	UB Dist	375469	$I$52>=$I$54	Not Binding	275469

$J$52	UB Nap	125156	$J$52>=$J$54	Not Binding	19115
$K$52	UB RES	250313	$K$52>=$K$54	Not Binding	150313
$L$52	UB Dist	100125	$L$52>=$L$54	Not Binding	125
$M$52	UB Nap	100125	$M$52>=$M$54	Not Binding	100125
$N$52	UB Nap	168750	$N$52>=$N$54	Not Binding	131250
$O$52	UB Dist	112500	$O$52>=$O$54	Not Binding	112500
$C$54	Solution Dist	804324	$C$54>=$C$51	Not Binding	804324
$D$54	Solution Mogas	353704	$D$54>=$D$51	Not Binding	353704
$E$54	Solution Hi-Sev	1782000	$E$54>=$E$51	Not Binding	1782000
$F$54	Solution Dist	810000	$F$54>=$F$51	Not Binding	810000
$G$54	Solution Mogas	12948	$G$54>=$G$51	Not Binding	12948
$H$54	Solution Hi-Sev	810000	$H$54>=$H$51	Not Binding	810000
$I$54	Solution Dist	50000	$I$54>=$I$51	Binding	0
$J$54	Solution Nap	53021	$J$54>=$J$51	Not Binding	53021
$K$54	Solution RES	50000	$K$54>=$K$51	Binding	0
$L$54	Solution Dist	50000	$L$54>=$L$51	Binding	0
$M$54	Solution Nap	100125	$M$54>=$M$51	Not Binding	100125
$N$54	Solution Nap	150000	$N$54>=$N$51	Not Binding	150000
$O$54	Solution Dist	0	$O$54>=$O$51	Binding	0

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/27/92 15:45

Changing Cells

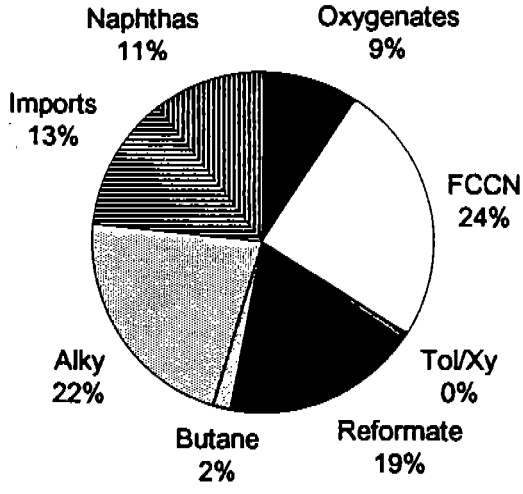
Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$54	Solution Dist	804324	0	9.250919506	2.917362859	0.135000005
$D$54	Solution Mogas	353704	0	8.659215776	0.135000005	2.186597297
$E$54	Solution Hi-Sev	1782000	0	6.897995378	4.154934887	1E+30
$F$54	Solution Dist	810000	0	9.410919506	0.135000005	1E+30
$G$54	Solution Mogas	12948	0	8.95421578	8.645614876	0.135000005
$H$54	Solution Hi-Sev	810000	0	7.171995378	4.175934891	1E+30
$I$54	Solution Dist	50000	8	16.49206725	1E+30	7.843260681
$J$54	Solution Nap	53021	0	9.039073501	9.943425314	0.706234622
$K$54	Solution RES	50000	11	7.386821251	1E+30	10.91279491
$L$54	Solution Dist	50000	8	16.85791725	1E+30	7.86872606
$M$54	Solution Nap	100125	0	8.6732235	0.706234622	1E+30
$N$54	Solution Nap	150000	0	10.63683751	1.327651189	1E+30
$O$54	Solution Dist	0	3	11.67602837	1E+30	3.433379179

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$U$37	Naphtha Calculated Level	203,397	0	89008.07162	114389.108	1E+30
$U$38	LCO Calculated Level	1,300,166	0	250000	1050165.568	1E+30
$U$39	Distillate & Jet Calculated Level	161,000	11	0	1528.313852	12434.67071
$U$40	Butane & C4 Calculated Level	899,664	56	899664.2729	1066.315597	1959.402658
$U$41	FCCN Calculated Level	2,225,325	0	1725000	500324.7296	1E+30
$U$42	FCCU Cap Calculated Level	4,572,977	0	5400000	1E+30	827023.4375
$U$43	H-C Cap Calculated Level	303,146	0	500625	1E+30	197479.4633
$U$44	HOC Cap Calculated Level	150,000	0	225000	1E+30	75000
$U$45	H-Oil Feed Calculated Level	-112,500	2	-112500	2681.692064	7160.079105
$U$46	Ares Feed Calculated Level	-954,595	15	-954595.3125	743.8234348	7288.677505
$U$47	VRES Feed Calculated Level	-759,202	0	-760728.3634	1526.744825	1E+30
$U$48	VGO Feed Calculated Level	-1,988,284	0	-1988283.782	229907.8702	8416.385938
$U$49	HGO Feed Calculated Level	-1,174,010	0	-2406149.6	1232139.464	1E+30
$C$52	UB Dist	810000	0	0	5676.13961	1E+30
$D$52	UB Mogas	2700000	0	0	2346295.584	1E+30
$E$52	UB Hi-Sev	1782000	4	0	24167.86725	44409.53825
$F$52	UB Dist	810000	0	0	5676.139607	12948.28606
$G$52	UB Mogas	1350000	0	0	1337051.714	1E+30
$H$52	UB Hi-Sev	810000	4	0	24167.8672	10025.26529
$I$52	UB Dist	375469	0	0	325468.75	1E+30
$J$52	UB Nap	125156	0	0	72135.71333	1E+30
$K$52	UB RES	250313	0	0	200312.5	1E+30
$L$52	UB Dist	100125	0	0	50125	1E+30
$M$52	UB Nap	100125	1	0	6106.979298	11221.84792

$N$52 UB Nap	168750	0	0	18750	1E+30
$O$52 UB Dist	112500	0	0	112500	1E+30

Gasoline Composition



Winter Gasoline Blend — Ten Percent ETOH — 1996 Environmental Standards

Obj. F'n. Values ($/bbl)	31.20	34.33	29.72	30.01	30.51	29.56	24.69	31.45	29.88	30.69	51.24	36.96	38.46	38.81	18.52
				Variables											
Constraint	Reformate Full	Reformate Heavy	Reformate "LITE"	FCCN Full	FCCN Light	FCCN Heavy	SR Naphtha	IG-1 Imported	IG-2 Imported	Alky-Poly	ETOH	MTBE	MTBE Imported	ETBE	N-butane
Volume: LB	1403980	150000	1000000	500000	250000	250000	848515	250000	0	625000	0	402975	219046	72279	250000
Volume: UB	1403980	150000	1000000	500000	250000	250000	848515	250000	0	625000	0	402975	219046	72279	250000
FCCN	0	0	0	909091	490196	408163	0	0	0	0	0	0	0	0	0
Reformate	1733309	230769	1136364	0	0	0	0	0	0	0	0	0	0	0	25000
Olefins	9828	750	50000	145500	99500	41250	12728	25000	0	31250	0	0	0	0	0
Aromatics	878892	130800	350000	146000	33750	150750	59396	68750	0	25000	0	0	0	0	6750
Oxygen	0	0	0	0	0	0	0	6750	0	0	0	73341	39866	11348	0
MON	122707871	14175000	85000000	40350000	20200000	20325000	61941576	21750000	0	56937500	0	41103450	22342706	7444728	22400000
RON	137168868	15735000	95000000	46050000	23150000	22975000	63638606	24500000	0	58250000	0	47148075	25628398	8601190	23550000
RVP	14039802	405000	8000000	3550000	2475000	650000	10182177	2500000	0	4687500	0	3143205	1708560	361395	13750000
Lt. Olefin Feed	0	0	0	0	0	0	0	0	0	718750	0	317303	0	49506	0
Benzene	14040	3000	7500	7500	3125	5000	12728	1875	0	3125	0	0	0	0	0
Ethanol	0	0	0	0	0	0	0	0	0	0	0	0	0	30694	0
Lower Bound	150,000	150,000	250,000	500,000	250,000	250,000	125,000	0	0	625,000	0	0	0	0	0
Upper Bound	2,250,000	500,000	1,000,000	1,750,000	800,000	975,000	2,051,844	250,000	450,000	1,532,486	7,339	402,975	375,000	72,279	250,000
Objective Function		1.942E+08													
Variables	1403980	150000	1000000	500000	250000	250000	848515	250000	0	625000	0	402975	219046	72279	250000

Mixing Values	Benzene	Aromatics	Olefins	Oxygen	RVP		Oxygenate	FCCN	Tol/Xy	Reformate	Butane	Alky	Imports	Naphthas	
	1.00%	29.29%	6.43%	2.02%	10.50		694,300	1,000,000	49,823	2,553,980	250,000	625,000	250,000	1,065,896	
							10.70%	15.41%	0.77%	39.36%	3.85%	9.63%	3.85%	16.43%	
Octane Values															
RON	98	105	95	92	93	92	75	98	92	93	106	117	117	119	94
MON	87	95	85	81	81	81	73	87	84	91	89	102	102	103	90

30.16 24.07

Toluene/ Xylene	Isomerate & Cnap	<,>,=	Level	Current Level	Constraint in Units/bbl	Constraint
49823	217382	>	6,489,000	6,489,000	6489000	Volume: LB
49823	217382	<	8,111,250	6,489,000	8111250	Volume: UB
0	0	<	5,400,000	1,807,450	5400000	FCCN
0	0	<	4,000,000	3,125,442	4000000	Reformate
0	1522	<	973,350	417,327	0.150	Olefins
47482	3043	<	2,271,150	1,900,613	0.350	Aromatics
0	0	>	131,306	131,306	0.020	Oxygen
5027177	18042675	>	545,556,822	559,747,684	84.074	MON
5495517	19564348	>	616,455,000	616,455,000	95.000	RON
59788	2608580	<	68,134,500	68,121,006	10.500	RVP: Max
0	0	<	2,141,913	1,085,559	2141913	Light Olefin Feed
3737	3261	<	64,890	64,890	0.010	Benzene
0	0	<	48,924	30,694	7.500E-01	ETOH Prod.
0	0		2300000	Lower Bound Total		
75,000	217382		12959304	Upper Bound Total		

		Total Mogas (b/d)	Average Cost ($/bbl)
49823	217382	6,489,000	$29.92
			Average cost ($/gal)
			$0.712
			Total ETOH Used
			721,000
			Average Cost of Motor Fuel ($/bbl)
			$32.06

Subtotal		
6,489,000		
100.00%		Final Octane
110	90	95
101	83	84

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/27/92 17:20

Target Cell (Min)

Cell	Name	Original Value	Final Value
$D$25	Objective Function F	1.942E+08	1.942E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	1403980	1403980
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	1000000	1000000
$F$27	Variables Full	500000	500000
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	250000	250000
$I$27	Variables Naphtha	848515	848515
$J$27	Variables Imported	250000	250000
$K$27	Variables Imported	0	0
$L$27	Variables Alky-Poly	625000	625000
$M$27	Variables ETOH	0	0
$N$27	Variables MTBE	402975	402975
$O$27	Variables Imported	219046	219046
$P$27	Variables ETBE	72279	72279
$Q$27	Variables N-butane	250000	250000
$R$27	Variables Xylene	49823	49823
$S$27	Variables & Cnap	217382	217382

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	6,489,000	$V$7<=$W$7	Not Binding	6,489,000
$W$8	< Current Level	6,489,000	$W$8<=$V$8	Not Binding	1,622,250
$W$9	< Current Level	1,807,450	$W$9<=$V$9	Not Binding	3,592,550
$W$10	< Current Level	3,125,442	$W$10<=$V$10	Not Binding	874,558
$W$11	< Current Level	417,327	$W$11<=$V$11	Not Binding	556,023
$W$12	< Current Level	1,900,613	$W$12<=$V$12	Not Binding	370,537
$W$13	> Current Level	131,306	$W$13>=$V$13	Binding	0
$W$14	> Current Level	559,747,684	$W$14>=$V$14	Not Binding	531,365,960
$W$15	> Current Level	616,455,000	$W$15>=$V$15	Not Binding	616,455,000
$W$16	< Current Level	68,121,006	$W$16<=$V$16	Not Binding	13,494
$W$17	< Current Level	1,085,559	$W$17<=$V$17	Not Binding	1,056,354
$W$18	< Current Level	64,890	$W$18<=$V$18	Binding	0
$W$19	< Current Level	30,694	$W$19<=$V$19	Not Binding	18,230
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	2,657,960
$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	1,750,000

$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	500,000
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	250,000
$I$21	Lower Bound Naphtl	125,000	$I$21<=$I$27	Not Binding	1,572,029
$J$21	Lower Bound Import	0	$J$21<=$J$27	Not Binding	500,000
$K$21	Lower Bound Import	0	$K$21<=$K$27	Binding	0
$L$21	Lower Bound Alky-P	625,000	$L$21<=$L$27	Not Binding	625,000
$M$21	Lower Bound ETOH	0	$M$21<=$M$27	Binding	0
$N$21	Lower Bound MTBE	0	$N$21<=$N$27	Not Binding	805,950
$O$21	Lower Bound Import	0	$O$21<=$O$27	Not Binding	438,092
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Not Binding	144,558
$Q$21	Lower Bound N-buta	0	$Q$21<=$Q$27	Not Binding	500,000
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Not Binding	99,647
$S$21	Lower Bound & Cna	0	$S$21<=$S$27	Not Binding	434,763
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	557,960
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,000,000	$E$22>=$E$27	Not Binding	1,000,000
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	750,000
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	475,000
$I$22	Upper Bound Naphtl	2,051,844	$I$22>=$I$27	Not Binding	354,814
$J$22	Upper Bound Import	250,000	$J$22>=$J$27	Not Binding	250,000
$K$22	Upper Bound Import	450,000	$K$22>=$K$27	Not Binding	450,000
$L$22	Upper Bound Alky-P	1,532,486	$L$22>=$L$27	Not Binding	282,486
$M$22	Upper Bound ETOH	7,339	$M$22>=$M$27	Not Binding	7,339
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Not Binding	402,975
$O$22	Upper Bound Import	375,000	$O$22>=$O$27	Not Binding	63,092
$P$22	Upper Bound ETBE	72,279	$P$22>=$P$27	Not Binding	72,279
$Q$22	Upper Bound N-buta	250,000	$Q$22>=$Q$27	Not Binding	250,000
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	24,647
$S$22	Upper Bound & Cna	217382	$S$22>=$S$27	Not Binding	217382

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/27/92 17:21

Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$27	Variables Full	1403980	0	31.204558	0.140310904	0.042193044
$D$27	Variables Heavy	150000	0	34.3250138	1E+30	1.849448406
$E$27	Variables "LITE"	1000000	0	29.71862667	0.923397905	1E+30
$F$27	Variables Full	500000	0	30.01460471	1E+30	0.676754705
$G$27	Variables Light	250000	0	30.51460471	1E+30	0.868953629
$H$27	Variables Heavy	250000	0	29.56438563	1E+30	0.624554158
$I$27	Variables Naphtha	848515	0	24.687	0.071136503	1.469952101
$J$27	Variables Imported	250000	0	31.454175	0.199462775	1E+30
$K$27	Variables Imported	0	0	29.88278866	1E+30	0.087779465
$L$27	Variables Alky-Poly	625000	0	30.687	1E+30	0.362727277
$M$27	Variables ETOH	0	0	51.23913288	1E+30	14.62624421
$N$27	Variables MTBE	402975	0	36.96	1.500000001	1E+30
$O$27	Variables Imported	219046	0	38.46	1.065049397	0.017132198
$P$27	Variables ETBE	72279	0	38.808	0.014778874	1E+30
$Q$27	Variables N-butane	250000	0	18.51525	12.42462487	1E+30
$R$27	Variables Xylene	49823	0	30.16440607	2.868761343	4.103352326
$S$27	Variables & Cnap	217382	0	24.069825	4.696867981	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$V$7	> Level	6,489,000	-31	0	161057.1924	1179.541671
$W$8	< Current Level	6,489,000	0	8111250	1E+30	1622250
$W$9	< Current Level	1,807,450	0	5400000	1E+30	3592549.747
$W$10	< Current Level	3,125,442	0	4000000	1E+30	874558.2184
$W$11	< Current Level	417,327	0	973350	1E+30	556022.746
$W$12	< Current Level	1,900,613	0	2271150	1E+30	370537.3415
$W$13	> Current Level	131,306	7	131305.636	28383.60311	2132.15606
$W$14	> Current Level	559,747,684	0	0	14190861.69	1E+30
$W$15	> Current Level	616,455,000	0	0	7746850.955	119312.6737
$W$16	< Current Level	68,121,006	0	68134500	1E+30	13493.92605
$W$17	< Current Level	1,085,559	0	2141912.769	1E+30	1056354.15
$W$18	< Current Level	64,890	-69	64890	1706.354836	118.9299108
$W$19	< Current Level	30,694	0	48923.67906	1E+30	18229.8947
$C$21	Lower Bound Full	150,000	0	0	1E+30	1253980.221
$D$21	Lower Bound Heavy	150,000	-2	0	2521.716	291457.2062
$E$21	Lower Bound "LITE"	250,000	0	0	1E+30	750000
$F$21	Lower Bound Full	500,000	-1	0	4549.477945	896529.1839
$G$21	Lower Bound Light	250,000	-1	0	34323.22928	550000
$H$21	Lower Bound Heavy	250,000	-1	0	1949.608417	387137.6021
$I$21	Lower Bound Naphtha	125,000	0	0	1E+30	723514.7409

$J$21	Lower Bound Imported	0	0	0	1E+30	250000
$K$21	Lower Bound Imported	0	0	0	37911.33147	449999.1928
$L$21	Lower Bound Alky-Poly	625,000	0	0	3773.212754	284810.6969
$M$21	Lower Bound ETOH	0	-15	0	83481.26454	902.2052128
$N$21	Lower Bound MTBE	0	0	0	1E+30	402975
$O$21	Lower Bound Imported	0	0	0	1E+30	219046.1368
$P$21	Lower Bound ETBE	0	0	0	1E+30	72278.91156
$Q$21	Lower Bound N-butane	0	0	0	1E+30	250000
$R$21	Lower Bound Xylene	0	0	0	1E+30	49823.36381
$S$21	Lower Bound & Cnap	0	0	0	1E+30	217381.6262
$C$22	Upper Bound Full	2,250,000	0	0	846019.7793	1E+30
$D$22	Upper Bound Heavy	500,000	0	0	350000	1E+30
$E$22	Upper Bound "LITE"	1,000,000	1	0	5211.991673	551377.2922
$F$22	Upper Bound Full	1,750,000	0	0	1250000	1E+30
$G$22	Upper Bound Light	800,000	0	0	550000	1E+30
$H$22	Upper Bound Heavy	975,000	0	0	725000	1E+30
$I$22	Upper Bound Naphtha	2,051,844	0	0	1203329.171	1E+30
$J$22	Upper Bound Imported	250,000	0	0	171140.7323	1079245.923
$K$22	Upper Bound Imported	450,000	0	0	450000	1E+30
$L$22	Upper Bound Alky-Poly	1,532,486	0	0	907486.25	1E+30
$M$22	Upper Bound ETOH	7,339	0	0	7338.551859	1E+30
$N$22	Upper Bound MTBE	402,975	2	0	155953.8632	219046.1368
$O$22	Upper Bound Imported	375,000	0	0	155953.8632	1E+30
$P$22	Upper Bound ETBE	72,279	0	0	4939.166543	42928.46171
$Q$22	Upper Bound N-butane	250,000	12	0	250000	310.4225048
$R$22	Upper Bound Xylene	75,000	0	0	25176.63619	1E+30
$S$22	Upper Bound & Cnap	217382	5	0	217381.6262	7954.178251

Catalytic Cracking and Hydrocracking Distillation Model

	FCCU - VGO			FCCU - HGO		Hydrocracker - VGO		r		- HGO
	Dist	Mogas	Hi-Sev	Dist	Mogas	Hi-Sev	Dist	Nap	RES	Dist
	9.25	8.66	6.90	9.41	8.95	7.17	16.49	9.04	7.39	16.86
Naphtha	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.08	0.10	0.15
LCO	0.54	0.21	0.16	0.54	0.21	0.16	-0.25	-0.25	0.00	-0.25
Distillate	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.65	0.94
C4	0.12	0.17	0.22	0.12	0.17	0.22	0.03	0.21	0.03	0.03
FCCN	0.32	0.59	0.55	0.32	0.59	0.55	0.00	0.00	0.00	0.00
FCCU Cap	1	1	1	1	1	1	0	0	0	0
H-C Cap	0	0	0	0	0	0	1	1	1	1
HOC Cap	0	0	0	0	0	0	0	0	0	0
H-Oil Feed	0	0	0	0	0	0	0	0	0	0
Ares Feed	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	0.000	0.000	-0.800	0.000
VRES Feed	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.250	-0.250	-0.200	0.000
VGO Feed	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750	-0.750	0.000	0.000
HGO Feed	0.000	0.000	0.000	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750
LB	0	0	0	0	0	0	50000	0	50000	50000
UB	810000	2700000	1782000	810000	1350000	810000	431789	143930	287859	115144
Solution	810000	1064792	0	810000	0	0	94804	27912	287859	50000

$31,832,527

Output	b/d
Naphtha	217382
Light Hydrocrackate	108691
LCO	1026442
Distillate	384724
Butane & C4	435004
FCCN	1204002
Ares	-767246
Vres	-528470

Capacity Utilization	
FCCU	49.72%
Hydrocracker	100.00%
HOC	66.67%

10 % ETOH in Gasoline Supply

Nap	HOC Nap	HOC Dist		Constraint
8.67	10.64	11.68		Constraint
1.08	0.12	0.07	>	217,382
-0.25	0.00	0.00	>	250,000
0.00	0.23	0.47	>	384,724
0.21	0.17	0.08	>	425,387
0.00	0.48	0.35	>	1,000,000
0	0.00	0.00	<	5,400,000
1	0.00	0.00	<	575,719
0	1.00	1.00	<	225,000
0	-0.750	-0.750	>	-112,500
0.000	0.000	0.000	>	-954,595
0.000	-0.250	-0.250	>	-760,728
0.000	0.000	0.000	>	-1,988,284
-0.750	0.000	0.000	>	-2,406,150
0	0	0		
115144	168750	112500		9,637,116
115144	37500	112500		3,410,511

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/27/92 17:55

Target Cell (Min)

Cell	Name	Original Value	Final Value
$A$55	Solution	$35,409,309	$31,832,527

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$54	Solution Dist	810000	810000
$D$54	Solution Mogas	1586491	1064792
$E$54	Solution Hi-Sev	0	0
$F$54	Solution Dist	810000	810000
$G$54	Solution Mogas	0	0
$H$54	Solution Hi-Sev	0	0
$I$54	Solution Dist	50000	94804
$J$54	Solution Nap	52879	27912
$K$54	Solution RES	247621	287859
$L$54	Solution Dist	50000	50000
$M$54	Solution Nap	100125	115144
$N$54	Solution Nap	37500	37500
$O$54	Solution Dist	112500	112500

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$U$37	Naphtha Calculated Level	217,382	$U$37>=$Q$37	Binding	0
$U$38	LCO Calculated Level	1,026,442	$U$38>=$Q$38	Not Binding	776,442
$U$39	Distillate & Jet Calculated Level	384,724	$U$39>=$Q$39	Not Binding	384,724
$U$40	Butane & C4 Calculated Level	435,004	$U$40>=$Q$40	Not Binding	9,617
$U$41	FCCN Calculated Level	1,204,002	$U$41>=$Q$41	Not Binding	204,002
$U$42	FCCU Cap Calculated Level	2,684,792	$U$42<=$Q$42	Not Binding	2,715,208
$U$43	H-C Cap Calculated Level	575,719	$U$43<=$Q$43	Binding	0
$U$44	HOC Cap Calculated Level	150,000	$U$44<=$Q$44	Not Binding	75,000
$U$45	H-Oil Feed Calculated Level	-112,500	$U$45>=$Q$45	Binding	0
$U$46	Ares Feed Calculated Level	-767,246	$U$46>=$Q$46	Not Binding	187,349
$U$47	VRES Feed Calculated Level	-528,470	$U$47>=$Q$47	Not Binding	232,259
$U$48	VGO Feed Calculated Level	-1,310,652	$U$48>=$Q$48	Not Binding	677,632
$U$49	HGO Feed Calculated Level	-650,358	$U$49>=$Q$49	Not Binding	1,755,792
$C$52	UB Dist	810000	$C$52>=$C$54	Not Binding	810000
$D$52	UB Mogas	2700000	$D$52>=$D$54	Not Binding	570416
$E$52	UB Hi-Sev	1782000	$E$52>=$E$54	Not Binding	1782000
$F$52	UB Dist	810000	$F$52>=$F$54	Not Binding	810000
$G$52	UB Mogas	1350000	$G$52>=$G$54	Not Binding	1350000
$H$52	UB Hi-Sev	810000	$H$52>=$H$54	Not Binding	810000
$I$52	UB Dist	431789	$I$52>=$I$54	Not Binding	242182

$J$52	UB Nap	143930	$J$52>=$J$54	Not Binding	88106
$K$52	UB RES	287859	$K$52>=$K$54	Not Binding	287859
$L$52	UB Dist	115144	$L$52>=$L$54	Not Binding	15144
$M$52	UB Nap	115144	$M$52>=$M$54	Not Binding	115144
$N$52	UB Nap	168750	$N$52>=$N$54	Not Binding	93750
$O$52	UB Dist	112500	$O$52>=$O$54	Not Binding	112500
$C$54	Solution Dist	810000	$C$54>=$C$51	Not Binding	810000
$D$54	Solution Mogas	1064792	$D$54>=$D$51	Not Binding	1064792
$E$54	Solution Hi-Sev	0	$E$54>=$E$51	Binding	0
$F$54	Solution Dist	810000	$F$54>=$F$51	Not Binding	810000
$G$54	Solution Mogas	0	$G$54>=$G$51	Binding	0
$H$54	Solution Hi-Sev	0	$H$54>=$H$51	Binding	0
$I$54	Solution Dist	94804	$I$54>=$I$51	Not Binding	44804
$J$54	Solution Nap	27912	$J$54>=$J$51	Not Binding	27912
$K$54	Solution RES	287859	$K$54>=$K$51	Not Binding	237859
$L$54	Solution Dist	50000	$L$54>=$L$51	Binding	0
$M$54	Solution Nap	115144	$M$54>=$M$51	Not Binding	115144
$N$54	Solution Nap	37500	$N$54>=$N$51	Not Binding	37500
$O$54	Solution Dist	112500	$O$54>=$O$51	Not Binding	112500

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/27/92 17:55

Changing Cells

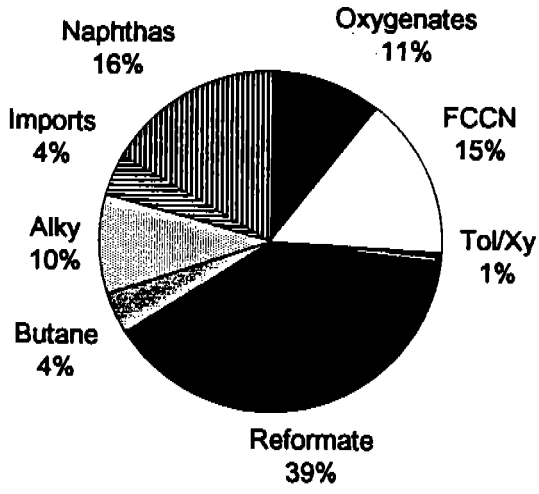
Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$54	Solution Dist	810000	0	9.250919506	13.01563535	1E+30
$D$54	Solution Mogas	1064792	0	8.659215776	0.295	1.725668767
$E$54	Solution Hi-Sev	0	0	6.897995378	1E+30	0.300497644
$F$54	Solution Dist	810000	0	9.410919506	12.85563535	1E+30
$G$54	Solution Mogas	0	0	8.954215776	1E+30	0.295
$H$54	Solution Hi-Sev	0	1	7.171995378	1E+30	0.574497644
$I$54	Solution Dist	94804	0	16.49206725	0.36585	5.478158453
$J$54	Solution Nap	27912	0	9.0390735	107.3719057	0.365850001
$K$54	Solution RES	287859	0	7.38682125	5.772683101	1E+30
$L$54	Solution Dist	50000	0	16.85791725	1E+30	0.36585
$M$54	Solution Nap	115144	0	8.6732235	0.365850001	1E+30
$N$54	Solution Nap	37500	0	10.63683751	2.886717799	7.173848748
$O$54	Solution Dist	112500	0	11.6760469	7.173848748	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$U$37	Naphtha Calculated Leve	217,382	34	217381.6262	41667.43628	9366.373739
$U$38	LCO Calculated Level	1,026,442	0	250000	776441.5009	1E+30
$U$39	Distillate & Jet Calculatec	384,724	41	0	196716.8585	11741.92877
$U$40	Butane & C4 Calculated I	435,004	0	425386.7525	9617.198801	1E+30
$U$41	FCCN Calculated Level	1,204,002	0	1000000	204002.3493	1E+30
$U$42	FCCU Cap Calculated Le	2,684,792	0	5400000	1E+30	2715207.883
$U$43	H-C Cap Calculated Leve	575,719	-17	575718.75	13934.743	38580.95952
$U$44	HOC Cap Calculated Lev	150,000	0	225000	1E+30	75000
$U$45	H-Oil Feed Calculated Le	-112,500	4	-112500	28125	50583.30171
$U$46	Ares Feed Calculated Le	-767,246	0	-954595.3125	187349.389	1E+30
$U$47	VRES Feed Calculated L	-528,470	0	-760728.3634	232258.7645	1E+30
$U$48	VGO Feed Calculated Le	-1,310,652	0	-1988283.782	677632.1871	1E+30
$U$49	HGO Feed Calculated Le	-650,358	0	-2406149.6	1755791.787	1E+30
$C$52	UB Dist	810000	13	0	596111.6923	29840.59912
$D$52	UB Mogas	2700000	0	0	1635207.883	1E+30
$E$52	UB Hi-Sev	1782000	0	0	1782000	1E+30
$F$52	UB Dist	810000	13	0	405420.9666	29840.59912
$G$52	UB Mogas	1350000	0	0	1350000	1E+30
$H$52	UB Hi-Sev	810000	0	0	810000	1E+30
$I$52	UB Dist	431789	0	0	336985.3676	1E+30
$J$52	UB Nap	143930	0	0	116017.7574	1E+30
$K$52	UB RES	287859	6	0	120063.5991	42517.79212
$L$52	UB Dist	115144	0	0	65143.75	1E+30
$M$52	UB Nap	115144	0	0	115143.75	27911.93008

$N$52 UB Nap	168750	0	0	131250	1E+30
$O$52 UB Dist	112500	7	0	112500	37500

Gasoline Composition



Winter Gasoline Blend — 20% ETOH — 1996 Environmental Standards

Obj. F'n. Values ($/bbl)	31.20	34.32	29.71	30.01	30.51	29.56	24.69	31.45	29.88	30.69	51.24	36.96	38.21	38.81	18.52
				Variables											
Constraint	Reformate Full	Reformate Heavy	Reformate "LITE"	FCCN Full	FCCN Light	FCCN Heavy	SR Naphtha	IG-1 Imported	IG-2 Imported	Alky-Poly	ETOH	MTBE	MTBE Imported	ETBE	N-butane
Volume: LB	638441	150000	1500000	500000	250000	250000	999029	450000	350000	652141	21630	402975	375000	128403	250000
Volume: UB	638441	150000	1500000	500000	250000	250000	999029	450000	350000	652141	21630	402975	375000	128403	250000
FCCN	0	0	0	909091	490196	408163	0	0	0	0	0	0	0	0	0
Reformate	788199	230769	1704545	0	0	0	0	0	0	0	0	0	0	0	25000
Olefins	4469	750	75000	145500	99500	41250	14985	45000	38500	32607	0	0	0	0	0
Aromatics	399664	130800	525000	146000	33750	150750	69932	123750	115500	26086	0	0	0	0	6750
Oxygen	0	0	0	0	0	0	0	9000	7000	0	7354	73341	68250	20159	0
MON	55799735	14175000	127500000	40350000	20200000	20325000	72929083	39150000	29400000	59410074	1925070	41103450	36250000	13225469	22400000
RON	62375677	15735000	142500000	46050000	23150000	22975000	74927140	44100000	32375000	60779571	2292780	47148075	43875000	15279911	23550000
RVP	6384409	405000	12000000	3550000	2475000	650000	11988342	4612500	3675000	4891060	497490	3143205	2925000	642013	13750000
Lt. Olefin Feed	0	0	0	0	0	0	0	0	0	749963	0	317303	0	87947	0
Benzene	6384	3000	11250	7500	3125	5000	14985	2250	2625	3261	0	0	0	0	0
Ethanol	0	0	0	0	0	0	0	0	0	0	21630	0	0	54527	0
Lower Bound	150,000	150,000	250,000	500,000	250,000	250,000	125,000	337,500	262,500	625,000	21,630	302,231	281,250	0	0
Upper Bound	2,250,000	500,000	1,500,000	1,750,000	800,000	975,000	2,002,820	450,000	350,000	1,532,486	150,033	402,975	375,000	128,403	250,000
Objective Function		2.164E+08													
Variables	638441	150000	1500000	500000	250000	250000	999029	450000	350000	652141	21630	402975	375000	128403	250000

Mixing Values	Benzene	Aromatics	Olefins	Oxygen	RVP		Oxygenate	FCCN	Tol/Xy	Reformate	Butane	Alky	Imports	Naphthas	
	0.95%	25.00%	6.92%	2.57%	10.30		928,008	1,000,000	75,000	2,288,441	250,000	652,141	800,000	1,216,410	
							12.87%	13.87%	1.04%	31.74%	3.47%	9.04%	11.10%	16.87%	
Octane Values															
RON	98	105	95	92	93	92	75	98	93	93	106	117	117	119	94
MON	87	95	85	81	81	81	73	87	84	91	89	102	102	103	90

30.16 24.07

Toluene/ Xylene	Isomerate & Cnap	<,>,=	Level	Current Level	Constraint in Units/bbl	Constraint
75000	217382	>	7,210,000	7,210,000	7210000	Volume: LB
75000	217382	<	9,012,500	7,210,000	9012500	Volume: UB
0	0	<	5,400,000	1,807,450	5400000	FCCN
0	0	<	4,000,000	2,748,513	4000000	Reformate
0	1522	<	757,482	499,083	0.105	Olefins
71475	3043	<	1,802,500	1,802,500	0.250	Aromatics
0	0	>	134,380	185,105	0.019	Oxygen
7567500	18042675	>	606,362,929	621,753,057	84.100	MON
8272500	19564346	>	684,950,000	684,950,000	95.000	RON
90000	2608580	<	75,705,000	74,287,599	10.500	RVP: Max
0	0	<	2,046,130	1,155,212	2046130	Light Olefin Feed
5625	3261	<	72,100	68,266	0.010	Benzene
0	0	<	1,500,326	76,157	2.300E+01	ETOH Prod.
0	0		3505111	Lower Bound Total		
75,000	217382		13709098	Upper Bound Total		

		Total Mogas (b/d)	Average Cost ($/bbl)
75000	217382	7,210,000	$30.01
			Average cost ($/gal)
			$0.715
			Total ETOH Used
			1,442,000
			Average Cost of Motor Fuel ($/bbl)
			$34.26

Subtotal		Final Octane
7,210,000		
100.00%		
110	90	95
101	83	84

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/28/92 15:50

Target Cell (Min)

Cell	Name	Original Value	Final Value
$D$25	Objective Function Heavy	2.164E+08	2.164E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	638441	638441
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	1500000	1500000
$F$27	Variables Full	500000	500000
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	250000	250000
$I$27	Variables Naphtha	999033	999029
$J$27	Variables Imported	450000	450000
$K$27	Variables Imported	350000	350000
$L$27	Variables Alky-Poly	652137	652141
$M$27	Variables ETOH	21630	21630
$N$27	Variables MTBE	402975	402975
$O$27	Variables Imported	375000	375000
$P$27	Variables ETBE	128403	128403
$Q$27	Variables N-butane	250000	250000
$R$27	Variables Xylene	75000	75000
$S$27	Variables & Cnap	217382	217382

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	7,210,000	$V$7<=$W$7	Not Binding	7,210,000
$W$8	< Current Level	7,210,000	$W$8<=$V$8	Not Binding	1,802,500
$W$9	< Current Level	1,807,450	$W$9<=$V$9	Not Binding	3,592,550
$W$10	< Current Level	2,748,513	$W$10<=$V$10	Not Binding	1,251,487
$W$11	< Current Level	499,083	$W$11<=$V$11	Not Binding	258,399
$W$12	< Current Level	1,802,500	$W$12<=$V$12	Binding	0
$W$13	> Current Level	185,105	$W$13>=$V$13	Not Binding	50,724
$W$14	> Current Level	621,753,057	$W$14>=$V$14	Not Binding	590,972,801
$W$15	> Current Level	684,950,000	$W$15>=$V$15	Not Binding	684,950,000
$W$16	< Current Level	74,287,599	$W$16<=$V$16	Not Binding	1,417,401
$W$17	< Current Level	1,155,212	$W$17<=$V$17	Not Binding	940,655
$W$18	< Current Level	68,266	$W$18<=$V$18	Not Binding	3,834
$W$19	< Current Level	76,157	$W$19<=$V$19	Not Binding	1,424,169
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	1,126,882
$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	2,750,000

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/28/92 15:51

Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$27	Variables Full	638441	0	31.19580493	0.2190615	0.206108637
$D$27	Variables Heavy	150000	0	34.31538542	1E+30	1.169512598
$E$27	Variables "LITE"	1500000	0	29.71029041	1.056055612	1E+30
$F$27	Variables Full	500000	0	30.00577808	1E+30	0.092357052
$G$27	Variables Light	250000	0	30.50577808	1E+30	0.170996996
$H$27	Variables Heavy	250000	0	29.55569141	1E+30	0.218492598
$I$27	Variables Naphtha	999029	0	24.687	0.248023057	0.631712397
$J$27	Variables Imported	450000	0	31.454175	0.416249991	1E+30
$K$27	Variables Imported	350000	0	29.88146625	0.10032343	1E+30
$L$27	Variables Alky-Poly	652141	0	30.687	0.222235804	0.140482424
$M$27	Variables ETOH	21630	0	51.24	1E+30	16.30217399
$N$27	Variables MTBE	402975	0	36.96	1.574417337	1E+30
$O$27	Variables Imported	375000	0	38.21	0.324417337	1E+30
$P$27	Variables ETBE	128403	0	38.808	0.380343033	1E+30
$Q$27	Variables N-butane	250000	0	18.51525	12.52006585	1E+30
$R$27	Variables Xylene	75000	0	30.15594476	4.622481775	1E+30
$S$27	Variables & Cnap	217382	0	24.069825	5.613599903	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$V$7	> Level	7,210,000	-31	0	23064.8863	207541.1538
$W$8	< Current Level	7,210,000	0	9012500	1E+30	1802500
$W$9	< Current Level	1,807,450	0	5400000	1E+30	3592549.747
$W$10	< Current Level	2,748,513	0	4000000	1E+30	1251486.665
$W$11	< Current Level	499,083	0	757482.3875	1E+30	258399.1359
$W$12	< Current Level	1,802,500	-2	1802500	12913.28811	289849.4215
$W$13	> Current Level	185,105	0	134380.3653	50724.49538	1E+30
$W$14	> Current Level	621,753,057	0	0	15390127.7	1E+30
$W$15	> Current Level	684,950,000	0	0	15888745.27	527215.1799
$W$16	< Current Level	74,287,599	0	75705000	1E+30	1417401.044
$W$17	< Current Level	1,155,212	0	2095867.173	1E+30	940655.1476
$W$18	< Current Level	68,266	0	72100	1E+30	3833.731925
$W$19	< Current Level	76,157	0	1500326.158	1E+30	1424169.02
$C$21	Lower Bound Full	150,000	0	0	1E+30	488440.9058
$D$21	Lower Bound Heavy	150,000	-1	0	185409.007	340484.3011
$E$21	Lower Bound "LITE"	250,000	0	0	1E+30	1250000
$F$21	Lower Bound Full	500,000	0	0	645717.8872	65603.9658
$G$21	Lower Bound Light	250,000	0	0	1063060.898	35274.14111
$H$21	Lower Bound Heavy	250,000	0	0	108458.8153	516797.2365
$I$21	Lower Bound Naphtha	125,000	0	0	1E+30	874028.5362

$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	500,000
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	250,000
$I$21	Lower Bound Naphtha	125,000	$I$21<=$I$27	Not Binding	1,873,057
$J$21	Lower Bound Imported	337,500	$J$21<=$J$27	Not Binding	562,500
$K$21	Lower Bound Imported	262,500	$K$21<=$K$27	Not Binding	437,500
$L$21	Lower Bound Alky-Poly	625,000	$L$21<=$L$27	Not Binding	679,283
$M$21	Lower Bound ETOH	21,630	$M$21<=$M$27	Not Binding	21,630
$N$21	Lower Bound MTBE	302,231	$N$21<=$N$27	Not Binding	503,719
$O$21	Lower Bound Imported	281,250	$O$21<=$O$27	Not Binding	468,750
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Not Binding	256,805
$Q$21	Lower Bound N-butane	0	$Q$21<=$Q$27	Not Binding	500,000
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Not Binding	150,000
$S$21	Lower Bound & Cnap	0	$S$21<=$S$27	Not Binding	434,763
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	973,118
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,500,000	$E$22>=$E$27	Not Binding	1,500,000
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	750,000
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	475,000
$I$22	Upper Bound Naphtha	2,002,820	$I$22>=$I$27	Not Binding	4,763
$J$22	Upper Bound Imported	450,000	$J$22>=$J$27	Not Binding	450,000
$K$22	Upper Bound Imported	350,000	$K$22>=$K$27	Not Binding	350,000
$L$22	Upper Bound Alky-Poly	1,532,486	$L$22>=$L$27	Not Binding	228,204
$M$22	Upper Bound ETOH	150,033	$M$22>=$M$27	Not Binding	106,773
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Not Binding	402,975
$O$22	Upper Bound Imported	375,000	$O$22>=$O$27	Not Binding	375,000
$P$22	Upper Bound ETBE	128,403	$P$22>=$P$27	Not Binding	128,403
$Q$22	Upper Bound N-butane	250,000	$Q$22>=$Q$27	Not Binding	250,000
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	75,000
$S$22	Upper Bound & Cnap	217382	$S$22>=$S$27	Not Binding	217382

$J$21	Lower Bound Imported	337,500	0	0	1E+30	112500
$K$21	Lower Bound Imported	262,500	0	0	1E+30	87500
$L$21	Lower Bound Alky-Poly	625,000	0	0	1E+30	27141.3159
$M$21	Lower Bound ETOH	21,630	-16	0	149189.6923	15571.40187
$N$21	Lower Bound MTBE	302,231	0	0	1E+30	100743.75
$O$21	Lower Bound Imported	281,250	0	0	1E+30	93750
$P$21	Lower Bound ETBE	0	0	0	1E+30	128402.6158
$Q$21	Lower Bound N-butane	0	0	0	1E+30	250000
$R$21	Lower Bound Xylene	0	0	0	1E+30	75000
$S$21	Lower Bound & Cnap	0	0	0	1E+30	217381.6262
$C$22	Upper Bound Full	2,250,000	0	0	1611559.094	1E+30
$D$22	Upper Bound Heavy	500,000	0	0	350000	1E+30
$E$22	Upper Bound "LITE"	1,500,000	1	0	1250000	61530.57095
$F$22	Upper Bound Full	1,750,000	0	0	1250000	1E+30
$G$22	Upper Bound Light	800,000	0	0	550000	1E+30
$H$22	Upper Bound Heavy	975,000	0	0	725000	1E+30
$I$22	Upper Bound Naphtha	2,002,820	0	0	1003791.551	1E+30
$J$22	Upper Bound Imported	450,000	0	0	112500	36035.60637
$K$22	Upper Bound Imported	350,000	0	0	87500	76575.66353
$L$22	Upper Bound Alky-Poly	1,532,486	0	0	880344.9341	1E+30
$M$22	Upper Bound ETOH	150,033	0	0	128402.6158	1E+30
$N$22	Upper Bound MTBE	402,975	2	0	100743.75	11753.00269
$O$22	Upper Bound Imported	375,000	0	0	93750	11753.00269
$P$22	Upper Bound ETBE	128,403	0	0	128402.6158	11251.35839
$Q$22	Upper Bound N-butane	250,000	13	0	250000	25158.70676
$R$22	Upper Bound Xylene	75,000	5	0	75000	56759.163
$S$22	Upper Bound & Cnap	217382	6	0	217381.6262	30498.96371

Winter Gasoline Blend | Distillation Model | 20% ETOH

Catalytic Cracking and Hydrocracking

	FCCU - VGO			FCCU - HGO			Hydrocracker - VGO		r	- HGO
	Dist	Mogas	Hi-Sev	Dist	Mogas	Hi-Sev	Dist	Nap	RES	Dist
	9.25	8.65	6.89	9.41	8.95	7.17	16.49	9.04	7.39	16.86
Naphtha	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.08	0.10	0.15
LCO	0.54	0.21	0.16	0.54	0.21	0.16	-0.25	-0.25	0.00	-0.25
Distillate	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.65	0.94
C4	0.12	0.17	0.22	0.12	0.17	0.22	0.03	0.21	0.03	0.03
FCCN	0.32	0.59	0.55	0.32	0.59	0.55	0.00	0.00	0.00	0.00
FCCU Cap	1	1	1	1	1	1	0	0	0	0
H-C Cap	0	0	0	0	0	0	1	1	1	1
HOC Cap	0	0	0	0	0	0	0	0	0	0
H-Oil Feed	0	0	0	0	0	0	0	0	0	0
Ares Feed	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	0.000	0.000	-0.800	0.000
VRES Feed	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.250	-0.250	-0.200	0.000
VGO Feed	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750	-0.750	0.000	0.000
HGO Feed	0.000	0.000	0.000	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750
LB	0	0	0	0	0	0	50000	0	50000	50000
UB	810000	2700000	1782000	810000	1350000	810000	466332	155444	310888	124355
Solution	810000	1842228	0	810000	358316	0	256283	5762	185376	50000

$43,542,186

Output	b/d
Naphtha	217382
Light Hydrocrackate	108691
LCO	1227814
Distillate	469901
Butane & C4	629705
FCCN	1874096
Ares	-912409
Vres	-713168

Capacity Utilization	
FCCU	70.75%
Hydrocracker	100.00%
HOC	66.67%

Winter Gasoline Blend | Distillation Model | 20% ETOH

Nap	HOC Nap	HOC Dist		Constraint
8.67	10.63	11.67		Constraint
1.08	0.12	0.07	>	217,382
-0.25	0.00	0.00	>	250,000
0.00	0.23	0.47	>	469,901
0.21	0.17	0.08	>	425,831
0.00	0.48	0.35	>	1,000,000
0	0.00	0.00	<	5,400,000
1	0.00	0.00	<	621,776
0	1.00	1.00	<	225,000
0	-0.750	-0.750	>	-112,500
0.000	0.000	0.000	>	-912,409
0.000	-0.250	-0.250	>	-731,617
0.000	0.000	0.000	>	-1,920,482
-0.750	0.000	0.000	>	-2,288,637
0	0	0		
124355	168750	112500		9,724,625
124355	37500	112500		4,592,320

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/28/92 16:02

Target Cell (Min)

Cell	Name	Original Value	Final Value
$A$55	Solution	$43,542,197	$43,542,186

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$54	Solution Dist	810000	810000
$D$54	Solution Mogas	1842228	1842228
$E$54	Solution Hi-Sev	0	0
$F$54	Solution Dist	810000	810000
$G$54	Solution Mogas	358317	358316
$H$54	Solution Hi-Sev	0	0
$I$54	Solution Dist	256283	256283
$J$54	Solution Nap	5762	5762
$K$54	Solution RES	185376	185376
$L$54	Solution Dist	50000	50000
$M$54	Solution Nap	124355	124355
$N$54	Solution Nap	37500	37500
$O$54	Solution Dist	112500	112500

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$U$37	Naphtha Calculated Level	217,382	$U$37>=$Q$37	Binding	0
$U$38	LCO Calculated Level	1,227,814	$U$38>=$Q$38	Not Binding	977,814
$U$39	Distillate & Jet Calculated Level	469,901	$U$39>=$Q$39	Not Binding	469,901
$U$40	Butane & C4 Calculated Level	629,705	$U$40>=$Q$40	Not Binding	203,874
$U$41	FCCN Calculated Level	1,874,096	$U$41>=$Q$41	Not Binding	874,096
$U$42	FCCU Cap Calculated Level	3,820,543	$U$42<=$Q$42	Not Binding	1,579,457
$U$43	H-C Cap Calculated Level	621,776	$U$43<=$Q$43	Binding	0
$U$44	HOC Cap Calculated Level	150,000	$U$44<=$Q$44	Not Binding	75,000
$U$45	H-Oil Feed Calculated Level	-112,500	$U$45>=$Q$45	Binding	0
$U$46	Ares Feed Calculated Level	-912,409	$U$46>=$Q$46	Binding	0
$U$47	VRES Feed Calculated Level	-713,168	$U$47>=$Q$47	Not Binding	18,449
$U$48	VGO Feed Calculated Level	-1,920,482	$U$48>=$Q$48	Binding	0
$U$49	HGO Feed Calculated Level	-890,172	$U$49>=$Q$49	Not Binding	1,398,466
$C$52	UB Dist	810000	$C$52>=$C$54	Not Binding	810000
$D$52	UB Mogas	2700000	$D$52>=$D$54	Not Binding	984455
$E$52	UB Hi-Sev	1782000	$E$52>=$E$54	Not Binding	1782000
$F$52	UB Dist	810000	$F$52>=$F$54	Not Binding	810000
$G$52	UB Mogas	1350000	$G$52>=$G$54	Not Binding	633369
$H$52	UB Hi-Sev	810000	$H$52>=$H$54	Not Binding	810000
$I$52	UB Dist	466332	$I$52>=$I$54	Not Binding	46235

$J$52	UB Nap	155444	$J$52>=$J$54	Not Binding	143920
$K$52	UB RES	310888	$K$52>=$K$54	Not Binding	59863
$L$52	UB Dist	124355	$L$52>=$L$54	Not Binding	24355
$M$52	UB Nap	124355	$M$52>=$M$54	Not Binding	124355
$N$52	UB Nap	168750	$N$52>=$N$54	Not Binding	93750
$O$52	UB Dist	112500	$O$52>=$O$54	Not Binding	112500
$C$54	Solution Dist	810000	$C$54>=$C$51	Not Binding	810000
$D$54	Solution Mogas	1842228	$D$54>=$D$51	Not Binding	1842228
$E$54	Solution Hi-Sev	0	$E$54>=$E$51	Binding	0
$F$54	Solution Dist	810000	$F$54>=$F$51	Not Binding	810000
$G$54	Solution Mogas	358316	$G$54>=$G$51	Not Binding	358316
$H$54	Solution Hi-Sev	0	$H$54>=$H$51	Binding	0
$I$54	Solution Dist	256283	$I$54>=$I$51	Not Binding	206283
$J$54	Solution Nap	5762	$J$54>=$J$51	Not Binding	5762
$K$54	Solution RES	185376	$K$54>=$K$51	Not Binding	135376
$L$54	Solution Dist	50000	$L$54>=$L$51	Binding	0
$M$54	Solution Nap	124355	$M$54>=$M$51	Not Binding	124355
$N$54	Solution Nap	37500	$N$54>=$N$51	Not Binding	37500
$O$54	Solution Dist	112500	$O$54>=$O$51	Not Binding	112500

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/28/92 16:02

Changing Cells

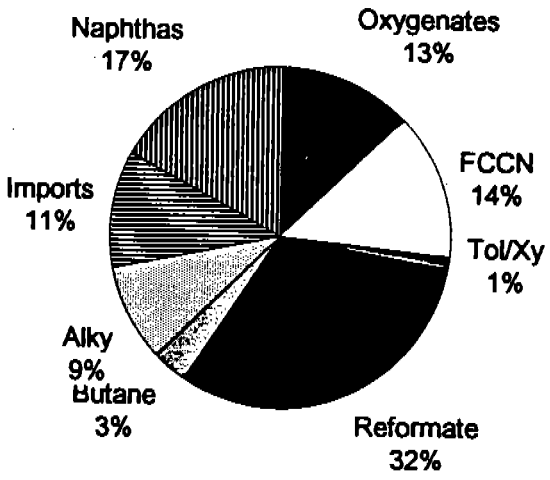
Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$54	Solution Dist	810000	0	9.248094985	15.59223239	1E+30
$D$54	Solution Mogas	1842228	0	8.654008065	0.295	0.022070001
$E$54	Solution Hi-Sev	0	1	6.893202662	1E+30	0.691610019
$F$54	Solution Dist	810000	0	9.408094985	15.72723239	1E+30
$G$54	Solution Mogas	358316	0	8.949008065	0.022070001	0.295
$H$54	Solution Hi-Sev	0	1	7.167160511	1E+30	0.670681937
$I$54	Solution Dist	256283	0	16.49206725	0.025465385	5.682612314
$J$54	Solution Nap	5762	0	9.039073503	111.3792014	0.706234632
$K$54	Solution RES	185376	0	7.38682125	5.988129105	1E+30
$L$54	Solution Dist	50000	0	16.85791725	1E+30	0.025465385
$M$54	Solution Nap	124355	0	8.6732235	0.706234632	1E+30
$N$54	Solution Nap	37500	0	10.63260073	5.636320639	8.653367035
$O$54	Solution Dist	112500	0	11.67295758	8.653367035	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$U$37	Naphtha Calculated Level	217,382	42	217381.6262	26130.05902	5666.324834
$U$38	LCO Calculated Level	1,227,814	0	250000	977813.9185	1E+30
$U$39	Distillate & Jet Calculated L	469,901	49	0	26411.0274	64694.61809
$U$40	Butane & C4 Calculated Le	629,705	0	425831.2163	203873.9081	1E+30
$U$41	FCCN Calculated Level	1,874,096	0	1000000	874095.5176	1E+30
$U$42	FCCU Cap Calculated Leve	3,820,543	0	5400000	1E+30	1579456.75
$U$43	H-C Cap Calculated Level	621,776	-23	621776.25	51142.21388	54600.52345
$U$44	HOC Cap Calculated Level	150,000	0	225000	1E+30	75000
$U$45	H-Oil Feed Calculated Leve	-112,500	8	-112500	28125	39742.55462
$U$46	Ares Feed Calculated Level	-912,409	7	-912409.125	94978.39721	111232.5085
$U$47	VRES Feed Calculated Lev	-713,168	0	-731616.6129	18448.65503	1E+30
$U$48	VGO Feed Calculated Leve	-1,920,482	0	-1920482.057	644594.8895	232905.1105
$U$49	HGO Feed Calculated Leve	-890,172	0	-2288637.2	1398465.652	1E+30
$C$52	UB Dist	810000	16	0	80033.41635	196044.2972
$D$52	UB Mogas	2700000	0	0	857772.3046	1E+30
$E$52	UB Hi-Sev	1782000	0	0	1782000	1E+30
$F$52	UB Dist	810000	16	0	80033.41635	126715.0225
$G$52	UB Mogas	1350000	0	0	991684.4453	1E+30
$H$52	UB Hi-Sev	810000	0	0	810000	1E+30
$I$52	UB Dist	466332	0	0	210048.7016	1E+30
$J$52	UB Nap	155444	0	0	149682.1422	1E+30
$K$52	UB RES	310888	0	0	125512.5313	1E+30
$L$52	UB Dist	124355	0	0	74355.25	1E+30
$M$52	UB Nap	124355	1	0	73794.62008	5761.92033

$N$52 UB Nap	168750	0	0	131250	1E+30
$O$52 UB Dist	112500	9	0	89042.24738	37500

Gasoline Composition



Winter Gasoline Blend — 30% ETOH — 1996 Environmental Standards

Obj. F'n. Values ($/bbl)	31.19	34.30	29.70	30.00	30.50	29.55	24.69	31.45	29.88	30.69	51.24	36.96	38.21	38.81	18.52
				Variables											
Constraint	Reformate Full	Reformate Heavy	Reformate "LITE"	FCCN Full	FCCN Light	FCCN Heavy	SR Naphtha	IG-1 Imported	IG-2 Imported	Alky-Poly	ETOH	MTBE	MTBE Imported	ETBE	N-butane
Volume: LB	150000	150000	677122	500000	250000	477816	501555	337500	262500	625000	22712	302231	281250	0	250000
Volume: UB	150000	150000	677122	500000	250000	477816	501555	337500	262500	625000	22712	302231	281250	0	250000
FCCN	0	0	0	909091	490196	780107	0	0	0	0	0	0	0	0	0
Reformate	185185	230769	769457	0	0	0	0	0	0	0	0	0	0	0	25000
Olefins	1050	750	33856	145500	99500	78840	7523	33750	28875	31250	0	0	0	0	0
Aromatics	93900	130800	236993	146000	33750	288123	35109	92813	86625	25000	0	0	0	0	6750
Oxygen	0	0	0	0	0	0	0	6750	5250	0	7722	55006	51168	0	0
MON	13110000	14175000	57555369	40350000	20200000	38846404	38613523	29362500	22050000	56937500	2021324	30827588	28687500	0	22400000
RON	14655000	15735000	64326589	46050000	23150000	43911249	37616633	33075000	24281250	58250000	2407419	35361056	32906250	0	23550000
RVP	1500000	405000	5416976	3550000	2475000	1242320	6018661	3459375	2756250	4687500	522365	2357404	2193750	0	13750000
Lt. Olefin Feed	0	0	0	0	0	0	0	0	0	718750	0	237977	0	0	0
Benzene	1500	3000	5078	7500	3125	9556	7523	1688	1969	3125	0	0	0	0	0
Ethanol	0	0	0	0	0	0	0	0	0	0	22712	0	0	0	0
Lower Bound	150,000	150,000	250,000	500,000	250,000	250,000	125,000	337,500	262,500	625,000	22,712	302,231	281,250	0	0
Upper Bound	2,250,000	500,000	1,500,000	1,750,000	800,000	975,000	1,953,796	450,000	350,000	1,532,486	150,033	402,975	375,000	127,321	250,000
Objective Function		1.509E+08													
Variables	150000	150000	677122	500000	250000	477816	501555	337500	262500	625000	22712	302231	281250	0	250000

Mixing Values	Benzene	Aromatics	Olefins	Oxygen	RVP		Oxygenate	FCCN	Tol/Xy	Reformate	Butane	Alky	Imports	Naphthas	
	1.00%	24.15%	9.16%	2.49%	10.50		606,193	1,227,816	41,933	977,122	250,000	625,000	600,000	718,937	
							12.01%	24.33%	0.83%	19.36%	4.95%	12.38%	11.89%	14.24%	
Octane Values															
RON	98	105	95	92	93	92	75	98	93	93	106	117	117	119	94
MON	87	95	85	81	81	81	73	87	84	91	89	102	102	103	90

Winter Gasoline Blend

30% ETOH

1996 Environmental Standards

Toluene/ Xylene	Isomerate & Cnap	<,>,=	Level	Current Level	Constraint in Units/bbl	Constraint
41933	217382	>	5,047,000	5,047,000	5047000	Volume: LB
41933	217382	<	6,308,750	5,047,000	6308750	Volume: UB
0	0	<	5,400,000	2,179,394	5400000	FCCN
0	0	<	4,000,000	1,210,411	4000000	Reformate
0	1522	<	541,182	462,416	0.107	Olefins
39962	3043	<	1,261,750	1,218,867	0.250	Aromatics
0	0	>	91,120	125,915	0.018	Oxygen
4231037	18042675	>	424,670,929	435,410,419	84.143	MON
4625207	19564346	>	479,465,000	479,465,000	95.000	RON
50320	2608580	<	52,993,500	52,993,500	10.500	RVP: Max
0	0	<	1,752,654	956,727	1752654	Light Olefin Feed
3145	3261	<	50,470	50,470	0.010	Benzene
0	0	<	1,500,328	22,712	2.300E+01	ETOH Prod.
0	0		3506193	Lower Bound Total		
75,000	217382		13658993	Upper Bound Total		

		Total Mogas (b/d)
41933	217382	5,047,000

Average Cost ($/bbl)
$29.90
Average cost ($/gal)
$0.712
Total ETOH Used
2,163,000
Average Cost of Motor Fuel ($/bbl)
$36.30

Subtotal		
5,047,000		
100.00%		Final Octane
110	90	95
101	83	84

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
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Target Cell (Min)

Cell	Name	Original Value	Final Value
$D$25	Objective Function Heavy	1.509E+08	1.509E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	150000	150000
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	677122	677122
$F$27	Variables Full	500000	500000
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	477816	477816
$I$27	Variables Naphtha	501555	501555
$J$27	Variables Imported	337500	337500
$K$27	Variables Imported	262500	262500
$L$27	Variables Alky-Poly	625000	625000
$M$27	Variables ETOH	22712	22712
$N$27	Variables MTBE	302231	302231
$O$27	Variables Imported	281250	281250
$P$27	Variables ETBE	0	0
$Q$27	Variables N-butane	250000	250000
$R$27	Variables Xylene	41933	41933
$S$27	Variables & Cnap	217382	217382

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	5,047,000	$V$7<=$W$7	Not Binding	5,047,000
$W$8	< Current Level	5,047,000	$W$8<=$V$8	Not Binding	1,261,750
$W$9	< Current Level	2,179,394	$W$9<=$V$9	Not Binding	3,220,606
$W$10	< Current Level	1,210,411	$W$10<=$V$10	Not Binding	2,789,589
$W$11	< Current Level	462,416	$W$11<=$V$11	Not Binding	78,767
$W$12	< Current Level	1,218,867	$W$12<=$V$12	Not Binding	42,883
$W$13	> Current Level	125,915	$W$13>=$V$13	Not Binding	34,795
$W$14	> Current Level	435,410,419	$W$14>=$V$14	Not Binding	413,931,438
$W$15	> Current Level	479,465,000	$W$15>=$V$15	Not Binding	479,465,000
$W$16	< Current Level	52,993,500	$W$16<=$V$16	Binding	0
$W$17	< Current Level	956,727	$W$17<=$V$17	Not Binding	795,927
$W$18	< Current Level	50,470	$W$18<=$V$18	Binding	0
$W$19	< Current Level	22,712	$W$19<=$V$19	Not Binding	1,477,615
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	150,000
$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	1,104,244

$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	500,000
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	705,631
$I$21	Lower Bound Naphtha	125,000	$I$21<=$I$27	Not Binding	878,110
$J$21	Lower Bound Imported	337,500	$J$21<=$J$27	Not Binding	337,500
$K$21	Lower Bound Imported	262,500	$K$21<=$K$27	Not Binding	262,500
$L$21	Lower Bound Alky-Poly	625,000	$L$21<=$L$27	Not Binding	625,000
$M$21	Lower Bound ETOH	22,712	$M$21<=$M$27	Not Binding	22,712
$N$21	Lower Bound MTBE	302,231	$N$21<=$N$27	Not Binding	302,231
$O$21	Lower Bound Imported	281,250	$O$21<=$O$27	Not Binding	281,250
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Binding	0
$Q$21	Lower Bound N-butane	0	$Q$21<=$Q$27	Not Binding	500,000
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Not Binding	83,866
$S$21	Lower Bound & Cnap	0	$S$21<=$S$27	Not Binding	434,763
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	1,950,000
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,500,000	$E$22>=$E$27	Not Binding	145,756
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	750,000
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	19,369
$I$22	Upper Bound Naphtha	1,953,796	$I$22>=$I$27	Not Binding	950,686
$J$22	Upper Bound Imported	450,000	$J$22>=$J$27	Not Binding	225,000
$K$22	Upper Bound Imported	350,000	$K$22>=$K$27	Not Binding	175,000
$L$22	Upper Bound Alky-Poly	1,532,486	$L$22>=$L$27	Not Binding	282,486
$M$22	Upper Bound ETOH	150,033	$M$22>=$M$27	Not Binding	104,610
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Not Binding	201,488
$O$22	Upper Bound Imported	375,000	$O$22>=$O$27	Not Binding	187,500
$P$22	Upper Bound ETBE	127,321	$P$22>=$P$27	Not Binding	127,321
$Q$22	Upper Bound N-butane	250,000	$Q$22>=$Q$27	Not Binding	250,000
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	8,866
$S$22	Upper Bound & Cnap	217382	$S$22>=$S$27	Not Binding	217382

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
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Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$27	Variables Full	150000	0	31.18634299	1E+30	1.544039045
$D$27	Variables Heavy	150000	0	34.30497729	1E+30	2.346779888
$E$27	Variables "LITE"	677122	0	29.70127904	1.032458358	0.25806918
$F$27	Variables Full	500000	0	29.99623663	1E+30	1.075906547
$G$27	Variables Light	250000	0	30.49623663	1E+30	1.929977854
$H$27	Variables Heavy	477816	0	29.54629308	0.182265251	1.147077383
$I$27	Variables Naphtha	501555	0	24.687	4.195209979	0.678659924
$J$27	Variables Imported	337500	0	31.454175	1E+30	1.523134363
$K$27	Variables Imported	262500	0	29.88146625	1E+30	1.175118851
$L$27	Variables Alky-Poly	625000	0	30.687	1E+30	1.074538148
$M$27	Variables ETOH	22712	0	51.24	1E+30	22.21439444
$N$27	Variables MTBE	302231	0	36.96	1E+30	2.671251816
$O$27	Variables Imported	281250	0	38.21	1E+30	3.921251817
$P$27	Variables ETBE	0	0	38.80858421	1E+30	3.55523767
$Q$27	Variables N-butane	250000	0	18.51525	1.555717016	1E+30
$R$27	Variables Xylene	41933	0	30.14679822	3.776970735	1.280610182
$S$27	Variables & Cnap	217382	0	24.069825	3.42446689	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$V$7	> Level	5,047,000	-32	0	96995.18947	63613.20896
$W$8	< Current Level	5,047,000	0	6308750	1E+30	1261750
$W$9	< Current Level	2,179,394	0	5400000	1E+30	3220605.994
$W$10	< Current Level	1,210,411	0	4000000	1E+30	2789588.775
$W$11	< Current Level	462,416	0	541182.3875	1E+30	78766.72426
$W$12	< Current Level	1,218,867	0	1261750	1E+30	42882.702
$W$13	> Current Level	125,915	0	91120.3653	34795.1322	1E+30
$W$14	> Current Level	435,410,419	0	0	10739490.55	1E+30
$W$15	> Current Level	479,465,000	0	0	2911999.224	3692765.969
$W$16	< Current Level	52,993,500	0	52993500	1162231.223	987782.689
$W$17	< Current Level	956,727	0	1752653.584	1E+30	795926.6973
$W$18	< Current Level	50,470	-57	50470	2188.836626	2775.708639
$W$19	< Current Level	22,712	0	1500326.158	1E+30	1477614.658
$C$21	Lower Bound Full	150,000	-2	0	263839.345	127018.7069
$D$21	Lower Bound Heavy	150,000	-2	0	219764.3628	226721.217
$E$21	Lower Bound "LITE"	250,000	0	0	1E+30	427121.9921
$F$21	Lower Bound Full	500,000	-1	0	422583.4061	350431.0989
$G$21	Lower Bound Light	250,000	-2	0	323109.1858	198845.7702
$H$21	Lower Bound Heavy	250,000	0	0	1E+30	227815.5491
$I$21	Lower Bound Naphtha	125,000	0	0	1E+30	376555.1085

$J$21	Lower Bound Imported	337,500	-2	0	445916.5818	112500
$K$21	Lower Bound Imported	262,500	-1	0	634975.4656	87500
$L$21	Lower Bound Alky-Poly	625,000	-1	0	137304.2502	456517.1363
$M$21	Lower Bound ETOH	22,712	-22	0	72796.39042	95655.19006
$N$21	Lower Bound MTBE	302,231	-3	0	89715.7966	100743.75
$O$21	Lower Bound Imported	281,250	-4	0	89715.79661	93750
$P$21	Lower Bound ETBE	0	-4	0	70016.25192	127321.0727
$Q$21	Lower Bound N-butane	0	0	0	1E+30	250000
$R$21	Lower Bound Xylene	0	0	0	1E+30	41932.97409
$S$21	Lower Bound & Cnap	0	0	0	1E+30	217381.6262
$C$22	Upper Bound Full	2,250,000	0	0	2100000	1E+30
$D$22	Upper Bound Heavy	500,000	0	0	350000	1E+30
$E$22	Upper Bound "LITE"	1,500,000	0	0	822878.0079	1E+30
$F$22	Upper Bound Full	1,750,000	0	0	1250000	1E+30
$G$22	Upper Bound Light	800,000	0	0	550000	1E+30
$H$22	Upper Bound Heavy	975,000	0	0	497184.4509	1E+30
$I$22	Upper Bound Naphtha	1,953,796	0	0	1452241.154	1E+30
$J$22	Upper Bound Imported	450,000	0	0	112500	1E+30
$K$22	Upper Bound Imported	350,000	0	0	87500	1E+30
$L$22	Upper Bound Alky-Poly	1,532,486	0	0	907486.25	1E+30
$M$22	Upper Bound ETOH	150,033	0	0	127321.1158	1E+30
$N$22	Upper Bound MTBE	402,975	0	0	100743.75	1E+30
$O$22	Upper Bound Imported	375,000	0	0	93750	1E+30
$P$22	Upper Bound ETBE	127,321	0	0	127321.1158	1E+30
$Q$22	Upper Bound N-butane	250,000	2	0	26690.49558	24563.56063
$R$22	Upper Bound Xylene	75,000	0	0	33067.02591	1E+30
$S$22	Upper Bound & Cnap	217382	3	0	194133.2816	246184.3979

Winter Gasoline Blend

Distillation Model

30% ETOH

Catalytic Cracking and Hydrocracking

	FCCU - VGO			FCCU - HGO			Hydrocracker - VGO		r	- HGO
	Dist	Mogas	Hi-Sev	Dist	Mogas	Hi-Sev	Dist	Nap	RES	Dist
	9.25	8.65	6.89	9.41	8.94	7.16	16.49	9.04	7.39	16.86
Naphtha	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.08	0.10	0.15
LCO	0.54	0.21	0.16	0.54	0.21	0.16	-0.25	-0.25	0.00	-0.25
Distillate	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.65	0.94
C4	0.12	0.17	0.22	0.12	0.17	0.22	0.03	0.21	0.03	0.03
FCCN	0.32	0.59	0.55	0.32	0.59	0.55	0.00	0.00	0.00	0.00
FCCU Cap	1	1	1	1	1	1	0	0	0	0
H-C Cap	0	0	0	0	0	0	1	1	1	1
HOC Cap	0	0	0	0	0	0	0	0	0	0
H-Oil Feed	0	0	0	0	0	0	0	0	0	0
Ares Feed	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	0.000	0.000	-0.800	0.000
VRES Feed	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.250	-0.250	-0.200	0.000
VGO Feed	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750	-0.750	0.000	0.000
HGO Feed	0.000	0.000	0.000	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750
LB	0	0	0	0	0	0	50000	0	50000	50000
UB	810000	2700000	1782000	1350000	1890000	1350000	483604	161201	322403	225682
Solution	810000	1503401	0	1350000	0	0	297197	0	171928	50000

$43,002,995

Output	b/d
Naphtha	217382
Light Hydrocrackate	108691
LCO	1363895
Distillate	499618
Butane & C4	574497
FCCN	1635582
Ares	-870223
Vres	-695695

Capacity Utilization	
FCCU	67.84%
Hydrocracker	100.00%
HOC	66.67%

Nap	HOC Nap	HOC Dist		
8.67	10.63	11.67		Constraint
1.08	0.12	0.07	>	217,382
-0.25	0.00	0.00	>	250,000
0.00	0.23	0.47	>	499,618
0.21	0.17	0.08	>	554,499
0.00	0.48	0.35	>	1,227,816
0	0.00	0.00	<	5,400,000
1	0.00	0.00	<	644,805
0	1.00	1.00	<	225,000
0	-0.750	-0.750	>	-112,500
0.000	0.000	0.000	>	-870,223
0.000	-0.250	-0.250	>	-702,505
0.000	0.000	0.000	>	-1,852,680
-0.750	0.000	0.000	>	-2,171,125
0	0	0		
161201	168750	112500		11,517,341
125680	37500	112500		4,458,206

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
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Target Cell (Min)

Cell	Name	Original Value	Final Value
$A$55	Solution	$43,002,995	$43,002,995

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$54	Solution Dist	810000	810000
$D$54	Solution Mogas	1503401	1503401
$E$54	Solution Hi-Sev	0	0
$F$54	Solution Dist	1350000	1350000
$G$54	Solution Mogas	0	0
$H$54	Solution Hi-Sev	0	0
$I$54	Solution Dist	297197	297197
$J$54	Solution Nap	0	0
$K$54	Solution RES	171928	171928
$L$54	Solution Dist	50000	50000
$M$54	Solution Nap	125680	125680
$N$54	Solution Nap	37500	37500
$O$54	Solution Dist	112500	112500

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$U$37	Naphtha Calculated Level	217,382	$U$37>=$Q$37	Binding	0
$U$38	LCO Calculated Level	1,363,895	$U$38>=$Q$38	Not Binding	1,113,895
$U$39	Distillate & Jet Calculated Level	499,618	$U$39>=$Q$39	Not Binding	499,618
$U$40	Butane & C4 Calculated Level	574,497	$U$40>=$Q$40	Not Binding	19,999
$U$41	FCCN Calculated Level	1,635,582	$U$41>=$Q$41	Not Binding	407,766
$U$42	FCCU Cap Calculated Level	3,663,401	$U$42<=$Q$42	Not Binding	1,736,599
$U$43	H-C Cap Calculated Level	644,805	$U$43<=$Q$43	Binding	0
$U$44	HOC Cap Calculated Level	150,000	$U$44<=$Q$44	Not Binding	75,000
$U$45	H-Oil Feed Calculated Level	-112,500	$U$45>=$Q$45	Binding	0
$U$46	Ares Feed Calculated Level	-870,223	$U$46>=$Q$46	Binding	0
$U$47	VRES Feed Calculated Level	-695,695	$U$47>=$Q$47	Not Binding	6,810
$U$48	VGO Feed Calculated Level	-1,726,608	$U$48>=$Q$48	Not Binding	126,072
$U$49	HGO Feed Calculated Level	-1,009,260	$U$49>=$Q$49	Not Binding	1,161,865
$C$52	UB Dist	810000	$C$52>=$C$54	Not Binding	810000
$D$52	UB Mogas	2700000	$D$52>=$D$54	Not Binding	306803
$E$52	UB Hi-Sev	1782000	$E$52>=$E$54	Not Binding	1782000
$F$52	UB Dist	1350000	$F$52>=$F$54	Not Binding	1350000
$G$52	UB Mogas	1890000	$G$52>=$G$54	Not Binding	1890000
$H$52	UB Hi-Sev	1350000	$H$52>=$H$54	Not Binding	1350000
$I$52	UB Dist	483604	$I$52>=$I$54	Not Binding	110790

$J$52	UB Nap	161201	$J$52>=$J$54	Not Binding	161201
$K$52	UB RES	322403	$K$52>=$K$54	Not Binding	21454
$L$52	UB Dist	225682	$L$52>=$L$54	Not Binding	125682
$M$52	UB Nap	161201	$M$52>=$M$54	Not Binding	90159
$N$52	UB Nap	168750	$N$52>=$N$54	Not Binding	93750
$O$52	UB Dist	112500	$O$52>=$O$54	Not Binding	112500
$C$54	Solution Dist	810000	$C$54>=$C$51	Not Binding	810000
$D$54	Solution Mogas	1503401	$D$54>=$D$51	Not Binding	1503401
$E$54	Solution Hi-Sev	0	$E$54>=$E$51	Binding	0
$F$54	Solution Dist	1350000	$F$54>=$F$51	Not Binding	1350000
$G$54	Solution Mogas	0	$G$54>=$G$51	Binding	0
$H$54	Solution Hi-Sev	0	$H$54>=$H$51	Binding	0
$I$54	Solution Dist	297197	$I$54>=$I$51	Not Binding	247197
$J$54	Solution Nap	0	$J$54>=$J$51	Binding	0
$K$54	Solution RES	171928	$K$54>=$K$51	Not Binding	121928
$L$54	Solution Dist	50000	$L$54>=$L$51	Binding	0
$M$54	Solution Nap	125680	$M$54>=$M$51	Not Binding	125680
$N$54	Solution Nap	37500	$N$54>=$N$51	Not Binding	37500
$O$54	Solution Dist	112500	$O$54>=$O$51	Not Binding	112500

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
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Changing Cells

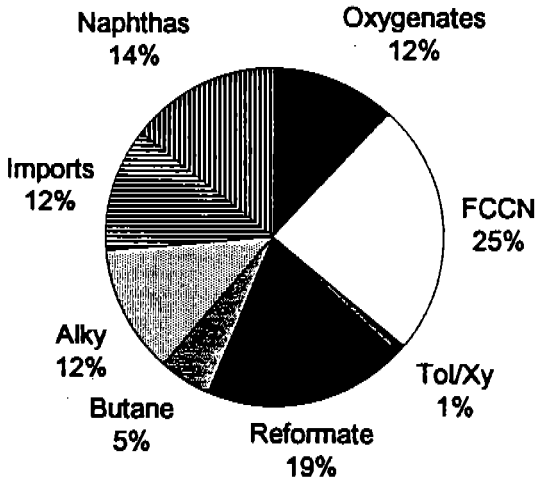
Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$54	Solution Dist	810000	0	9.245041721	15.04946643	1E+30
$D$54	Solution Mogas	1503401	0	8.64837861	0.295030664	3.323494499
$E$54	Solution Hi-Sev	0	1	6.88791275	1E+30	0.610096796
$F$54	Solution Dist	1350000	0	9.405041721	14.88946643	1E+30
$G$54	Solution Mogas	0	0	8.943378925	1E+30	0.295029623
$H$54	Solution Hi-Sev	0	1	7.161945105	1E+30	0.88412915
$I$54	Solution Dist	297197	0	16.49206725	0.36585	5.501258135
$J$54	Solution Nap	0	0	9.03904438	1E+30	0.365811743
$K$54	Solution RES	171928	0	7.38682125	5.797024701	1E+30
$L$54	Solution Dist	50000	0	16.85791725	1E+30	0.36585
$M$54	Solution Nap	125680	0	8.6732235	0.365811751	38.85937763
$N$54	Solution Nap	37500	0	10.62802083	5.018653353	8.361657718
$O$54	Solution Dist	112500	0	11.66961807	8.361657718	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$U$37	Naphtha Calculated Level	217,382	40	217381.6262	15072.14214	21280.57868
$U$38	LCO Calculated Level	1,363,895	0	250000	1113895.108	1E+30
$U$39	Distillate & Jet Calculated L	499,618	47	0	9551.389916	27284.87495
$U$40	Butane & C4 Calculated Le	574,497	0	554498.5081	19998.92423	1E+30
$U$41	FCCN Calculated Level	1,635,582	0	1227815.549	407766.2122	1E+30
$U$42	FCCU Cap Calculated Leve	3,663,401	0	5400000	1E+30	1736598.71
$U$43	H-C Cap Calculated Level	644,805	-22	644805	32375.72571	21987.11927
$U$44	HOC Cap Calculated Level	150,000	0	225000	1E+30	75000
$U$45	H-Oil Feed Calculated Leve	-112,500	7	-112500	28125	56250
$U$46	Ares Feed Calculated Level	-870,223	7	-870222.9375	108056.1121	133354.1526
$U$47	VRES Feed Calculated Lev	-695,695	0	-702504.8623	6809.807694	1E+30
$U$48	VGO Feed Calculated Leve	-1,726,608	0	-1852680.331	126071.9189	1E+30
$U$49	HGO Feed Calculated Leve	-1,009,260	0	-2171124.8	1161864.886	1E+30
$C$52	UB Dist	810000	15	0	28943.60581	68051.50233
$D$52	UB Mogas	2700000	0	0	1196598.71	1E+30
$E$52	UB Hi-Sev	1782000	0	0	1782000	1E+30
$F$52	UB Dist	1350000	15	0	28943.60581	68051.50233
$G$52	UB Mogas	1890000	0	0	1890000	1E+30
$H$52	UB Hi-Sev	1350000	0	0	1350000	1E+30
$I$52	UB Dist	483604	0	0	186406.985	1E+30
$J$52	UB Nap	161201	0	0	161201.25	1E+30
$K$52	UB RES	322403	0	0	150474.1507	1E+30
$L$52	UB Dist	225682	0	0	175681.75	1E+30
$M$52	UB Nap	161201	0	0	35521.36432	1E+30

$N$52	UB Nap	168750	0	0	131250	1E+30
$O$52	UB Dist	112500	8	0	45850.8331	37500

Gasoline Composition



Summer Gasoline Blend — 30% ETOH — 1996 Environmental Standards

Obj. F'n. Values ($/bbl)	31.19	34.30	29.70	30.00	30.50	29.55	24.69	31.45	29.88	30.69	51.24	36.96	38.21	38.81	18.52
				Variables											
Constraint	Reformate Full	Reformate Heavy	Reformate "LITE"	FCCN Full	FCCN Light	FCCN Heavy	SR Naphtha	IG-1 Imported	IG-2 Imported	Alky-Poly	ETOH	MTBE	MTBE Imported	ETBE	N-butane
Volume: LB	150000	150000	1070987	500000	250000	518000	478028	292500	227500	850000	24415	302231	281250	0	74726
Volume: UB	150000	150000	1070987	500000	250000	518000	478028	292500	227500	850000	24415	302231	281250	0	74726
FCCN	0	0	0	909091	490196	845715	0	0	0	0	0	0	0	0	0
Reformate	185185	230769	1217030	0	0	0	0	0	0	0	0	0	0	0	7473
Olefins	1050	750	53549	145500	99500	85470	7170	29250	25025	42500	0	0	0	0	0
Aromatics	93900	130800	374845	146000	33750	312354	33462	80438	75075	34000	0	0	0	0	2018
Oxygen	0	0	0	0	0	0	0	5850	4550	0	8301	55006	51188	0	0
MON	13110000	14175000	91033875	40350000	20200000	42113433	34896017	25447500	19110000	77435000	2172923	30827588	28687500	0	6695488
RON	14655000	15735000	101743743	46050000	23150000	47604237	35852073	28665000	21043750	79220000	2587975	35361056	32906250	0	7039229
RVP	1500000	405000	8567694	3550000	2475000	1346801	5736332	2383875	1899625	6375000	561542	2357404	2193750	0	4109953
Lt. Olefin Feed	0	0	0	0	0	0	0	0	0	977500	0	237977	0	0	0
Benzene	1500	3000	8032	7500	3125	10360	7170	1463	1706	4250	0	0	0	0	0
Ethanol	0	0	0	0	0	0	0	0	0	0	24415	0	0	0	0
Lower Bound	150,000	150,000	250,000	500,000	250,000	250,000	125,000	292,500	227,500	850,000	24,415	302,231	281,250	0	0
Upper Bound	2,250,000	500,000	1,500,000	1,750,000	800,000	975,000	1,953,798	450,000	350,000	1,532,488	150,033	402,975	375,000	125,618	250,000
Objective Function		1.644E+08													
Variables	150000	150000	1070987	500000	250000	518000	478028	292500	227500	850000	24415	302231	281250	0	74726

Mixing Values	Benzene	Aromatics	Olefins	Oxygen	RVP		Oxygenate	FCCN	Tol/Xy	Reformate	Butane	Alky	Imports	Naphthas	
	1.00%	25.00%	9.06%	2.30%	6.50		607,898	1,268,000	38,506	1,370,987	74,726	850,000	520,000	695,409	
							11.20%	23.37%	0.71%	25.27%	1.38%	15.67%	9.58%	12.82%	
Octane Values															
RON	98	105	95	92	93	92	75	98	93	93	106	117	117	119	94
MON	87	95	85	81	81	81	73	87	84	91	89	102	102	103	90

30.15 24.07

Toluene/ Xylene	Isomerate & Cnap	<,>,=	Level	Current Level	Constraint In Units/bbl	Constraint
38506	217382	>	5,425,525	5,425,525	5425525	Volume: LB
38506	217382	<	6,781,906	5,425,525	6781906	Volume: UB
0	0	<	5,400,000	2,245,002	5400000	FCCN
0	0	<	4,000,000	1,640,457	4000000	Reformate
0	1522	<	579,035	491,286	0.107	Olefins
36696	3043	<	1,356,381	1,356,381	0.250	Aromatics
0	0	>	98,691	124,895	0.018	Oxygen
3885258	18042675	>	456,467,029	468,162,257	84.133	MON
4247215	19564346	>	515,424,875	515,424,875	95.000	RON
46207	2608580	<	46,116,963	46,116,963	8.500	RVP: Max
0	0	<	1,971,197	1,215,477	1971197	Light Olefin Feed
2888	3261	<	54,255	54,255	0.010	Benzene
0	0	<	1,500,326	24,415	2.300E+01	ETOH Prod.
0	0		3652896	Lower Bound Total		
75,000	217382		13657290	Upper Bound Total		

		Total Mogas (b/d)	Average Cost ($/bbl)
38506	217382	5,425,525	$30.30
			Average cost ($/gal)
			$0.721
			Total ETOH Used
			2,325,225
			Average Cost of Motor Fuel ($/bbl)
			$36.58

	Subtotal	
	5,425,525	
	100.00%	Final
		Octane
110	90	95
101	83	84

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/31/92 10:47

Target Cell (Min)

Cell	Name	Original Value	Final Value
$D$25	Objective Function Heavy	1.644E+08	1.644E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	150000	150000
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	1070987	1070987
$F$27	Variables Full	500000	500000
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	518000	518000
$I$27	Variables Naphtha	478028	478028
$J$27	Variables Imported	292500	292500
$K$27	Variables Imported	227500	227500
$L$27	Variables Alky-Poly	850000	850000
$M$27	Variables ETOH	24415	24415
$N$27	Variables MTBE	302231	302231
$O$27	Variables Imported	281250	281250
$P$27	Variables ETBE	0	0
$Q$27	Variables N-butane	74726	74726
$R$27	Variables Xylene	38506	38506
$S$27	Variables & Cnap	217382	217382

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	5,425,525	$V$7<=$W$7	Not Binding	5,425,525
$W$8	< Current Level	5,425,525	$W$8<=$V$8	Not Binding	1,356,381
$W$9	< Current Level	2,245,002	$W$9<=$V$9	Not Binding	3,154,998
$W$10	< Current Level	1,640,457	$W$10<=$V$10	Not Binding	2,359,543
$W$11	< Current Level	491,286	$W$11<=$V$11	Not Binding	87,748
$W$12	< Current Level	1,356,381	$W$12<=$V$12	Binding	0
$W$13	> Current Level	124,895	$W$13>=$V$13	Not Binding	26;204
$W$14	> Current Level	468,182,257	$W$14>=$V$14	Not Binding	444,751,801
$W$15	> Current Level	515,424,875	$W$15>=$V$15	Not Binding	515,424,875
$W$16	< Current Level	46,116,963	$W$16<=$V$16	Binding	0
$W$17	< Current Level	1,215,477	$W$17<=$V$17	Not Binding	755,720
$W$18	< Current Level	54,255	$W$18<=$V$18	Binding	0
$W$19	< Current Level	24,415	$W$19<=$V$19	Not Binding	1,475,911
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	150,000
$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	1,891,974

$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	500,000
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	786,001
$I$21	Lower Bound Naphtha	125,000	$I$21<=$I$27	Not Binding	831,055
$J$21	Lower Bound Imported	292,500	$J$21<=$J$27	Not Binding	292,500
$K$21	Lower Bound Imported	227,500	$K$21<=$K$27	Not Binding	227,500
$L$21	Lower Bound Alky-Poly	850,000	$L$21<=$L$27	Not Binding	850,000
$M$21	Lower Bound ETOH	24,415	$M$21<=$M$27	Not Binding	24,415
$N$21	Lower Bound MTBE	302,231	$N$21<=$N$27	Not Binding	302,231
$O$21	Lower Bound Imported	281,250	$O$21<=$O$27	Not Binding	281,250
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Binding	0
$Q$21	Lower Bound N-butane	0	$Q$21<=$Q$27	Not Binding	149,453
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Not Binding	77,012
$S$21	Lower Bound & Cnap	0	$S$21<=$S$27	Not Binding	434,763
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	1,950,000
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,500,000	$E$22>=$E$27	Not Binding	641,974
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	750,000
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	61,001
$I$22	Upper Bound Naphtha	1,953,796	$I$22>=$I$27	Not Binding	997,741
$J$22	Upper Bound Imported	450,000	$J$22>=$J$27	Not Binding	135,000
$K$22	Upper Bound Imported	350,000	$K$22>=$K$27	Not Binding	105,000
$L$22	Upper Bound Alky-Poly	1,532,486	$L$22>=$L$27	Not Binding	167,514
$M$22	Upper Bound ETOH	150,033	$M$22>=$M$27	Not Binding	101,203
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Not Binding	201,488
$O$22	Upper Bound Imported	375,000	$O$22>=$O$27	Not Binding	187,500
$P$22	Upper Bound ETBE	125,618	$P$22>=$P$27	Not Binding	125,618
$Q$22	Upper Bound N-butane	250,000	$Q$22>=$Q$27	Not Binding	100,547
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	2,012
$S$22	Upper Bound & Cnap	217382	$S$22>=$S$27	Not Binding	217382

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/31/92 10:48

Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$27	Variables Full	150000	0	31.18634299	1E+30	1.84489197
$D$27	Variables Heavy	150000	0	34.30497729	1E+30	2.515330279
$E$27	Variables "LITE"	1070987	0	29.70127904	0.40674226	0.258069181
$F$27	Variables Full	500000	0	29.99623663	1E+30	0.985477181
$G$27	Variables Light	250000	0	30.49623663	1E+30	1.811966078
$H$27	Variables Heavy	518000	0	29.54629308	0.182265251	0.594583862
$I$27	Variables Naphtha	478028	0	24.687	1.915990751	0.678659927
$J$27	Variables Imported	292500	0	31.454175	1E+30	1.008954069
$K$27	Variables Imported	227500	0	29.88146625	1E+30	0.732003049
$L$27	Variables Alky-Poly	850000	0	30.687	1E+30	0.796222296
$M$27	Variables ETOH	24415	0	51.24	1E+30	22.43997441
$N$27	Variables MTBE	302231	0	36.96	1E+30	2.245307323
$O$27	Variables Imported	281250	0	38.21	1E+30	3.495307323
$P$27	Variables ETBE	0	0	38.80858421	1E+30	3.009020085
$Q$27	Variables N-butane	74726	0	18.51525	1.555717023	4.450686405
$R$27	Variables Xylene	38506	0	30.14679823	3.146491678	1.280610188
$S$27	Variables & Cnap	217382	0	24.069825	3.560944869	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$V$7	> Level	5,425,525	-32	0	260372.7695	152691.6208
$W$8	< Current Level	5,425,525	0	6781906.25	1E+30	1356381.25
$W$9	< Current Level	2,245,002	0	5400000	1E+30	3154998.061
$W$10	< Current Level	1,640,457	0	4000000	1E+30	2359542.528
$W$11	< Current Level	491,286	0	579034.8875	1E+30	87748.39606
$W$12	< Current Level	1,356,381	-1	1356381.25	55335.76347	52444.29962
$W$13	> Current Level	124,895	0	98690.8653	26203.77545	1E+30
$W$14	> Current Level	468,182,257	0	0	11715227.84	1E+30
$W$15	> Current Level	515,424,875	0	0	2300659.455	2427504.006
$W$16	< Current Level	46,116,963	0	46116962.5	7048334.97	3004998.747
$W$17	< Current Level	1,215,477	0	1971196.794	1E+30	755719.9079
$W$18	< Current Level	54,255	-54	54255.25	2114.540494	2231.123563
$W$19	< Current Level	24,415	0	1500326.158	1E+30	1475911.295
$C$21	Lower Bound Full	150,000	-2	0	351334.9494	232873.2193
$D$21	Lower Bound Heavy	150,000	-3	0	330495.8504	193814.227
$E$21	Lower Bound "LITE"	250,000	0	0	1E+30	820986.7644
$F$21	Lower Bound Full	500,000	-1	0	291065.2043	305620.8547
$G$21	Lower Bound Light	250,000	-2	0	187636.5506	183773.982
$H$21	Lower Bound Heavy	250,000	0	0	1E+30	268000.4078
$I$21	Lower Bound Naphtha	125,000	0	0	1E+30	353027.635

$J$21	Lower Bound Imported	292,500	-1	0	280131.8477	157500
$K$21	Lower Bound Imported	227,500	-1	0	512266.0845	122500
$L$21	Lower Bound Alky-Poly	850,000	-1	0	200130.9411	265746.8744
$M$21	Lower Bound ETOH	24,415	-22	0	77069.9278	125617.7533
$N$21	Lower Bound MTBE	302,231	-2	0	78746.42991	83088.03533
$O$21	Lower Bound Imported	281,250	-3	0	78746.4299	83088.03532
$P$21	Lower Bound ETBE	0	-3	0	72956.15481	76978.51922
$Q$21	Lower Bound N-butane	0	0	0	1E+30	74726.42487
$R$21	Lower Bound Xylene	0	0	0	1E+30	38506.02924
$S$21	Lower Bound & Cnap	0	0	0	1E+30	217381.6262
$C$22	Upper Bound Full	2,250,000	0	0	2100000	1E+30
$D$22	Upper Bound Heavy	500,000	0	0	350000	1E+30
$E$22	Upper Bound "LITE"	1,500,000	0	0	429013.2356	1E+30
$F$22	Upper Bound Full	1,750,000	0	0	1250000	1E+30
$G$22	Upper Bound Light	800,000	0	0	550000	1E+30
$H$22	Upper Bound Heavy	975,000	0	0	456999.5922	1E+30
$I$22	Upper Bound Naphtha	1,953,796	0	0	1475768.627	1E+30
$J$22	Upper Bound Imported	450,000	0	0	157500	1E+30
$K$22	Upper Bound Imported	350,000	0	0	122500	1E+30
$L$22	Upper Bound Alky-Poly	1,532,486	0	0	682486.25	1E+30
$M$22	Upper Bound ETOH	150,033	0	0	125617.7533	1E+30
$N$22	Upper Bound MTBE	402,975	0	0	100743.75	1E+30
$O$22	Upper Bound Imported	375,000	0	0	93750	1E+30
$P$22	Upper Bound ETBE	125,618	0	0	125617.7533	1E+30
$Q$22	Upper Bound N-butane	250,000	0	0	175273.5751	1E+30
$R$22	Upper Bound Xylene	75,000	0	0	36493.97076	1E+30
$S$22	Upper Bound & Cnap	217382	4	0	131792.7757	139059.0382

Catalytic Cracking and Hydrocracking

	FCCU - VGO			FCCU - HGO		Hydrocracker - VGO		r		- HGO
	Dist	Mogas	Hi-Sev	Dist	Mogas	Hi-Sev	Dist	Nap	RES	Dist
	9.25	8.65	6.89	9.41	8.94	7.16	16.49	9.04	7.39	16.86
Naphtha	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.08	0.10	0.15
LCO	0.54	0.21	0.16	0.54	0.21	0.16	-0.25	-0.25	0.00	-0.25
Distillate	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.65	0.94
C4	0.12	0.17	0.22	0.12	0.17	0.22	0.03	0.21	0.03	0.03
FCCN	0.32	0.59	0.55	0.32	0.59	0.55	0.00	0.00	0.00	0.00
FCCU Cap	1	1	1	1	1	1	0	0	0	0
H-C Cap	0	0	0	0	0	0	1	1	1	1
HOC Cap	0	0	0	0	0	0	0	0	0	0
H-Oil Feed	0	0	0	0	0	0	0	0	0	0
Ares Feed	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	0.000	0.000	-0.800	0.000
VRES Feed	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.250	-0.250	-0.200	0.000
VGO Feed	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750	-0.750	0.000	0.000
HGO Feed	0.000	0.000	0.000	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750
LB	0	0	0	0	0	0	50000	0	50000	50000
UB	810000	2700000	1782000	1350000	1890000	1350000	483604	161201	322403	225682
Solution	810000	377649	772794	1350000	0	0	204213	0	260168	50000

$37,749,475

Output	b/d
Naphtha	217382
Light Hydrocrackate	108691
LCO	1273194
Distillate	469569
Butane & C4	554499
FCCN	1394879
Ares	-870223
Vres	-637153

Capacity Utilization	
FCCU	61.30%
Hydrocracker	100.00%
HOC	66.67%

Nap	HOC Nap	HOC Dist		Constraint
8.67	10.63	11.67		Constraint
1.08	0.12	0.07	>	217,382
-0.25	0.00	0.00	>	250,000
0.00	0.23	0.47	>	469,569
0.21	0.17	0.08	>	587,087
0.00	0.48	0.35	>	1,268,000
0	0.00	0.00	<	5,400,000
1	0.00	0.00	<	644,805
0	1.00	1.00	<	225,000
0	-0.750	-0.750	>	-112,500
0.000	0.000	0.000	>	-870,223
0.000	-0.250	-0.250	>	-702,505
0.000	0.000	0.000	>	-1,852,680
-0.750	0.000	0.000	>	-2,171,125
0	0	0		
161201	168750	112500		11,517,341
130424	37500	112500		4,105,248

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/31/92 10:39

Target Cell (Min)

Cell	Name	Original Value	Final Value
$A$55	Solution	$46,911,953	$37,749,475

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$54	Solution Dist	810000	810000
$D$54	Solution Mogas	1757401	377649
$E$54	Solution Hi-Sev	0	772794
$F$54	Solution Dist	1350000	1350000
$G$54	Solution Mogas	103199	0
$H$54	Solution Hi-Sev	0	0
$I$54	Solution Dist	245160	204213
$J$54	Solution Nap	0	0
$K$54	Solution RES	50000	260168
$L$54	Solution Dist	225682	50000
$M$54	Solution Nap	123963	130424
$N$54	Solution Nap	0	37500
$O$54	Solution Dist	112500	112500

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$U$37	Naphtha Calculated Level	217,382	$U$37>=$Q$37	Binding	0
$U$38	LCO Calculated Level	1,273,194	$U$38>=$Q$38	Not Binding	1,023,194
$U$39	Distillate & Jet Calculated Level	469,569	$U$39>=$Q$39	Not Binding	469,569
$U$40	Butane & C4 Calculated Level	554,499	$U$40>=$Q$40	Binding	0
$U$41	FCCN Calculated Level	1,394,879	$U$41>=$Q$41	Not Binding	167,063
$U$42	FCCU Cap Calculated Level	3,310,443	$U$42<=$Q$42	Not Binding	2,089,557
$U$43	H-C Cap Calculated Level	644,805	$U$43<=$Q$43	Binding	0
$U$44	HOC Cap Calculated Level	150,000	$U$44<=$Q$44	Not Binding	75,000
$U$45	H-Oil Feed Calculated Level	-112,500	$U$45>=$Q$45	Binding	0
$U$46	Ares Feed Calculated Level	-870,223	$U$46>=$Q$46	Binding	0
$U$47	VRES Feed Calculated Level	-637,153	$U$47>=$Q$47	Not Binding	65,352
$U$48	VGO Feed Calculated Level	-1,427,448	$U$48>=$Q$48	Not Binding	425,233
$U$49	HGO Feed Calculated Level	-1,012,818	$U$49>=$Q$49	Not Binding	1,158,307
$C$52	UB Dist	810000	$C$52>=$C$54	Not Binding	810000
$D$52	UB Mogas	2700000	$D$52>=$D$54	Not Binding	1944702
$E$52	UB Hi-Sev	1782000	$E$52>=$E$54	Not Binding	236413
$F$52	UB Dist	1350000	$F$52>=$F$54	Not Binding	1350000
$G$52	UB Mogas	1890000	$G$52>=$G$54	Not Binding	1890000
$H$52	UB Hi-Sev	1350000	$H$52>=$H$54	Not Binding	1350000
$I$52	UB Dist	483604	$I$52>=$I$54	Not Binding	75178

$J$52	UB Nap	161201	$J$52>=$J$54	Not Binding	161201
$K$52	UB RES	322403	$K$52>=$K$54	Not Binding	197934
$L$52	UB Dist	225682	$L$52>=$L$54	Not Binding	125682
$M$52	UB Nap	161201	$M$52>=$M$54	Not Binding	99647
$N$52	UB Nap	168750	$N$52>=$N$54	Not Binding	93750
$O$52	UB Dist	112500	$O$52>=$O$54	Not Binding	112500
$C$54	Solution Dist	810000	$C$54>=$C$51	Not Binding	810000
$D$54	Solution Mogas	377649	$D$54>=$D$51	Not Binding	377649
$E$54	Solution Hi-Sev	772794	$E$54>=$E$51	Not Binding	772794
$F$54	Solution Dist	1350000	$F$54>=$F$51	Not Binding	1350000
$G$54	Solution Mogas	0	$G$54>=$G$51	Binding	0
$H$54	Solution Hi-Sev	0	$H$54>=$H$51	Binding	0
$I$54	Solution Dist	204213	$I$54>=$I$51	Not Binding	154213
$J$54	Solution Nap	0	$J$54>=$J$51	Binding	0
$K$54	Solution RES	260168	$K$54>=$K$51	Not Binding	210168
$L$54	Solution Dist	50000	$L$54>=$L$51	Binding	0
$M$54	Solution Nap	130424	$M$54>=$M$51	Not Binding	130424
$N$54	Solution Nap	37500	$N$54>=$N$51	Not Binding	37500
$O$54	Solution Dist	112500	$O$54>=$O$51	Not Binding	112500

Microsoft Excel 4.0 Sensitivity Report
Worksheet: [PADD-5.XLW]DISTC1.XLS
Report Created: 8/31/92 10:40

Changing Cells

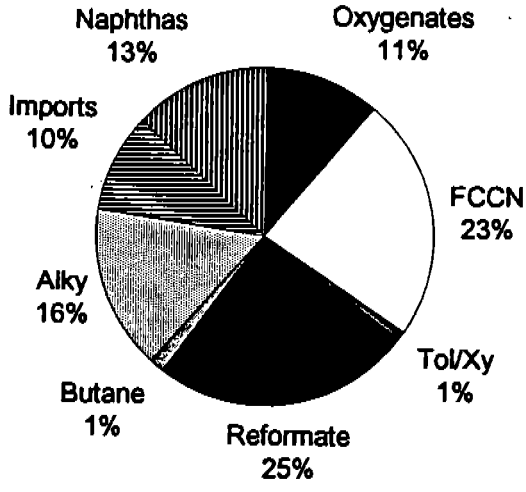
Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$54	Solution Dist	810000	0	9.245041721	13.02666238	1E+30
$D$54	Solution Mogas	377649	0	8.64837861	0.294999999	1.694681012
$E$54	Solution Hi-Sev	772794	0	6.887929672	0.274	0.610176749
$F$54	Solution Dist	1350000	0	9.405041721	12.86666238	1E+30
$G$54	Solution Mogas	0	0	8.94337861	1E+30	0.294999999
$H$54	Solution Hi-Sev	0	0	7.161929672	1E+30	0.274
$I$54	Solution Dist	204213	0	16.49206725	0.36585	5.745518254
$J$54	Solution Nap	0	0	9.0390735	1E+30	0.365850001
$K$54	Solution RES	260168	0	7.386821251	6.054417085	1E+30
$L$54	Solution Dist	50000	0	16.85791725	1E+30	0.36585
$M$54	Solution Nap	130424	0	8.6732235	0.365850001	31.5480028
$N$54	Solution Nap	37500	0	10.62802083	4.245298946	6.86854874
$O$54	Solution Dist	112500	0	11.66961807	6.86854874	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$U$37	Naphtha Calculated Level	217,382	33	217381.6262	29381.7861	29812.55509
$U$38	LCO Calculated Level	1,273,194	0	250000	1023194.032	1E+30
$U$39	Distillate & Jet Calculated L	469,569	42	0	93465.12504	35000.71402
$U$40	Butane & C4 Calculated Le	554,499	7	554498.5081	42643.275	68506.89099
$U$41	FCCN Calculated Level	1,394,879	0	1227815.549	167063.2923	1E+30
$U$42	FCCU Cap Calculated Leve	3,310,443	0	5400000	1E+30	2089557.337
$U$43	H-C Cap Calculated Level	644,805	-18	644805	41553.67453	110903.981
$U$44	HOC Cap Calculated Level	150,000	0	225000	1E+30	75000
$U$45	H-Oil Feed Calculated Leve	-112,500	6	-112500	28125	56250
$U$46	Ares Feed Calculated Level	-870,223	7	-870222.9375	177632.1148	52600.03647
$U$47	VRES Feed Calculated Lev	-637,153	0	-702504.8623	65351.60145	1E+30
$U$48	VGO Feed Calculated Leve	-1,427,448	0	-1852680.331	425232.8195	1E+30
$U$49	HGO Feed Calculated Leve	-1,012,818	0	-2171124.8	1158306.835	1E+30
$C$52	UB Dist	810000	13	0	233112.3813	75211.95608
$D$52	UB Mogas	2700000	0	0	2322350.908	1E+30
$E$52	UB Hi-Sev	1782000	0	0	1009206.429	1E+30
$F$52	UB Dist	1350000	13	0	233112.3813	75211.95608
$G$52	UB Mogas	1890000	0	0	1890000	1E+30
$H$52	UB Hi-Sev	1350000	0	0	1350000	1E+30
$I$52	UB Dist	483604	0	0	279390.7093	1E+30
$J$52	UB Nap	161201	0	0	161201.25	1E+30
$K$52	UB RES	322403	0	0	62234.49398	1E+30
$L$52	UB Dist	225682	0	0	175681.75	1E+30
$M$52	UB Nap	161201	0	0	30777.29675	1E+30

$N$52 UB Nap	168750	0	0	131250	1E+30
$O$52 UB Dist	112500	7	0	112500	37500

Gasoline Composition



Winter Gasoline Blend — 40% ETOH — 1996 Environmental Standards

Obj. F'n. Values ($/bbl)	31.18	34.29	29.69	29.99	30.49	29.54	24.69	31.45	29.88	30.69	51.24	36.96	38.21	38.81	18.52
				Variables											
Constraint	Reformate Full	Reformate Heavy	Reformate "LITE"	FCCN Full	FCCN Light	FCCN Heavy	SR Naphtha	IG-1 Imported	IG-2 Imported	Alky-Poly	ETOH	MTBE	MTBE Imported	ETBE	N-butane
Volume: LB	150000	150000	872616	500000	250000	250000	274029	292500	122500	631169	25956	233587	93750	0	213416
Volume: UB	150000	150000	872616	500000	250000	250000	274029	292500	122500	631169	25956	233587	93750	0	213416
FCCN	0	0	0	909091	490196	408163	0	0	0	0	0	0	0	0	0
Reformate	185185	230769	991609	0	0	0	0	0	0	0	0	0	0	0	21342
Olefins	1050	750	43631	145500	99500	41250	4110	29250	13475	31558	0	0	0	0	0
Aromatics	93900	130800	305416	146000	33750	150750	19182	80438	40425	25247	0	0	0	0	5762
Oxygen	0	0	0	0	0	0	0	5850	2450	0	8825	42513	17063	0	0
MON	13110000	14175000	74172374	40350000	20200000	20325000	20004137	25447500	10290000	57499527	2310084	23825869	9562500	0	19122049
RON	14655000	15735000	82898536	46050000	23150000	22975000	20552196	28665000	11331250	58824983	2751336	27329673	10968750	0	20103761
RVP	1500000	405000	6980929	3550000	2475000	650000	3288351	2998125	1286250	4733770	596988	1821978	731250	0	11737865
Lt. Olefin Feed	0	0	0	0	0	0	0	0	0	725845	0	183926	0	0	0
Benzene	1500	3000	6545	7500	3125	5000	4110	1463	919	3156	0	0	0	0	0
Ethanol	0	0	0	0	0	0	0	0	0	0	25956	0	0	0	0
Lower Bound	150,000	150,000	250,000	500,000	250,000	250,000	125,000	292,500	122,500	625,000	25,956	201,488	93,750	0	0
Upper Bound	2,250,000	500,000	1,500,000	1,750,000	800,000	975,000	1,904,772	450,000	350,000	1,532,486	150,033	402,975	375,000	124,077	250,000
Objective Function		1.289E+08													
Variables	150000	150000	872616	500000	250000	250000	274029	292500	122500	631169	25956	233587	93750	0	213416

Mixing Values	Benzene	Aromatics	Olefins	Oxygen	RVP		Oxygenate	FCCN	Tol/Xy	Reformate	Butane	Alky	Imports	Naphthas	
	1.00%	25.00%	9.51%	1.77%	10.50		353,293	1,000,000	49,095	1,172,616	213,416	631,169	415,000	491,411	
							8.17%	23.12%	1.13%	27.11%	4.93%	14.59%	9.59%	11.36%	
Octane Values															
RON	98	105	95	92	93	92	75	98	93	93	106	117	117	119	94
MON	87	95	85	81	81	81	73	87	84	91	89	102	102	103	90

Toluene/ Xylene	Isomerate & Cnap	<,>,=	Level	Current Level	Constraint in Units/bbl	Constraint
49095	217382	>	4,326,000	4,326,000	4326000	Volume: LB
49095	217382	<	5,407,500	4,326,000	5407500	Volume: UB
0	0	<	5,400,000	1,807,450	5400000	FCCN
0	0	<	4,000,000	1,428,905	4000000	Reformate
0	1522	<	469,082	411,596	0.108	Olefins
46787	3043	<	1,081,500	1,081,500	0.250	Aromatics
0	0	>	76,700	76,700	0.018	Oxygen
4953877	18042675	>	364,106,929	373,390,392	84.167	MON
5415169	19564346	>	410,970,000	410,970,000	95.000	RON
58914	2608580	<	45,423,000	45,423,000	10.500	RVP: Max
0	0	<	1,738,051	909,771	1738051	Light Olefin Feed
3682	3261	<	43,260	43,260	0.010	Benzene
0	0	<	1,500,326	25,956	2.300E+01	ETOH Prod.
0	0		3036194	Lower Bound Total		
75,000	217382		13606725	Upper Bound Total		

		Total Mogas (b/d)	Average Cost ($/bbl)
49095	217382	4,326,000	$29.80
			Average cost ($/gal)
			$0.710
			Total ETOH Used
			2,884,000
			Average Cost of Motor Fuel ($/bbl)
			$38.38

Subtotal		
4,326,000		
100.00%		Final
		Octane
110	90	95
101	83	84

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 8/31/92 17:04

Target Cell (Min)

Cell	Name	Original Value	Final Value
$D$25	Objective Function Heavy	1.289E+08	1.289E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	150000	150000
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	872616	872616
$F$27	Variables Full	500000	500000
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	250000	250000
$I$27	Variables Naphtha	274029	274029
$J$27	Variables Imported	292500	292500
$K$27	Variables Imported	122500	122500
$L$27	Variables Alky-Poly	631169	631169
$M$27	Variables ETOH	25956	25956
$N$27	Variables MTBE	233587	233587
$O$27	Variables Imported	93750	93750
$P$27	Variables ETBE	0	0
$Q$27	Variables N-butane	213416	213416
$R$27	Variables Xylene	49095	49095
$S$27	Variables & Cnap	217382	217382

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	4,326,000	$V$7<=$W$7	Not Binding	4,326,000
$W$8	< Current Level	4,326,000	$W$8<=$V$8	Not Binding	1,081,500
$W$9	< Current Level	1,807,450	$W$9<=$V$9	Not Binding	3,592,550
$W$10	< Current Level	1,428,905	$W$10<=$V$10	Not Binding	2,571,095
$W$11	< Current Level	411,596	$W$11<=$V$11	Not Binding	57,486
$W$12	< Current Level	1,081,500	$W$12<=$V$12	Binding	0
$W$13	> Current Level	76,700	$W$13>=$V$13	Binding	0
$W$14	> Current Level	373,390,392	$W$14>=$V$14	Not Binding	354,823,466
$W$15	> Current Level	410,970,000	$W$15>=$V$15	Not Binding	410,970,000
$W$16	< Current Level	45,423,000	$W$16<=$V$16	Binding	0
$W$17	< Current Level	909,771	$W$17<=$V$17	Not Binding	732,106
$W$18	< Current Level	43,260	$W$18<=$V$18	Binding	0
$W$19	< Current Level	25,956	$W$19<=$V$19	Not Binding	1,474,370
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	150,000
$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	1,495,232

$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	500,000
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	250,000
$I$21	Lower Bound Naphtha	125,000	$I$21<=$I$27	Not Binding	423,059
$J$21	Lower Bound Imported	292,500	$J$21<=$J$27	Not Binding	292,500
$K$21	Lower Bound Imported	122,500	$K$21<=$K$27	Not Binding	122,500
$L$21	Lower Bound Alky-Poly	625,000	$L$21<=$L$27	Not Binding	637,339
$M$21	Lower Bound ETOH	25,956	$M$21<=$M$27	Not Binding	25,956
$N$21	Lower Bound MTBE	201,488	$N$21<=$N$27	Not Binding	265,686
$O$21	Lower Bound Imported	93,750	$O$21<=$O$27	Not Binding	93,750
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Binding	0
$Q$21	Lower Bound N-butane	0	$Q$21<=$Q$27	Not Binding	426,831
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Not Binding	98,190
$S$21	Lower Bound & Cnap	0	$S$21<=$S$27	Not Binding	434,763
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	1,950,000
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,500,000	$E$22>=$E$27	Not Binding	245,232
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	750,000
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	475,000
$I$22	Upper Bound Naphtha	1,904,772	$I$22>=$I$27	Not Binding	1,356,714
$J$22	Upper Bound Imported	450,000	$J$22>=$J$27	Not Binding	135,000
$K$22	Upper Bound Imported	350,000	$K$22>=$K$27	Not Binding	105,000
$L$22	Upper Bound Alky-Poly	1,532,486	$L$22>=$L$27	Not Binding	270,148
$M$22	Upper Bound ETOH	150,033	$M$22>=$M$27	Not Binding	98,121
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Not Binding	64,199
$O$22	Upper Bound Imported	375,000	$O$22>=$O$27	Not Binding	187,500
$P$22	Upper Bound ETBE	124,077	$P$22>=$P$27	Not Binding	124,077
$Q$22	Upper Bound N-butane	250,000	$Q$22>=$Q$27	Not Binding	176,831
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	23,190
$S$22	Upper Bound & Cnap	217382	$S$22>=$S$27	Not Binding	217382

.0 Sensitivity Report
:.XLW]SUMEXPC1.XLS
ıd: 8/31/92 17:05

Changing Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$27	Variables Full	150000	0	31.17608244	1E+30	2.537155916
$D$27	Variables Heavy	150000	0	34.29369069	1E+30	3.349489374
$E$27	Variables "LITE"	872616	0	29.69150709	0.410276535	0.899196856
$F$27	Variables Full	500000	0	29.98588986	1E+30	0.81204161
$G$27	Variables Light	250000	0	30.48588986	1E+30	1.239749705
$H$27	Variables Heavy	250000	0	29.53610151	1E+30	0.599750336
$I$27	Variables Naphtha	274029	0	24.687	1.93263923	0.320238224
$J$27	Variables Imported	292500	0	31.454175	1E+30	1.22572968
$K$27	Variables Imported	122500	0	29.88146625	1E+30	1.325971959
$L$27	Variables Alky-Poly	631169	0	30.687	0.167701712	0.803140852
$M$27	Variables ETOH	25956	0	51.24	1E+30	20.58457996
$N$27	Variables MTBE	233587	0	36.96	0.794403026	0.390211263
$O$27	Variables Imported	93750	0	38.21	1E+30	1.25
$P$27	Variables ETBE	0	0	38.80858421	1E+30	0.685284408
$Q$27	Variables N-butane	213416	0	18.51525	2.738868199	4.48935943
$R$27	Variables Xylene	49095	0	30.13687969	2.700803496	22.9720129
$S$27	Variables & Cnap	217382	0	24.069825	4.368869845	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$V$7	> Level	4,326,000	-33	0	4706.954715	485709.7979
$W$8	< Current Level	4,326,000	0	5407500	1E+30	1081500
$W$9	< Current Level	1,807,450	0	5400000	1E+30	3592549.747
$W$10	< Current Level	1,428,905	0	4000000	1E+30	2571094.734
$W$11	< Current Level	411,596	0	469082.3875	1E+30	57486.00144
$W$12	< Current Level	1,081,500	-4	1081500	1689.757437	155271.2053
$W$13	> Current Level	76,700	2	76700.3653	482.5564611	5842.100297
$W$14	> Current Level	373,390,392	0	0	9283463.116	1E+30
$W$15	> Current Level	410,970,000	0	0	3048153.946	114833.4565
$W$16	< Current Level	45,423,000	0	45423000	290227.7393	10131516.71
$W$17	< Current Level	909,771	0	1641876.727	1E+30	732105.6142
$W$18	< Current Level	43,260	-39	43260	1773.420625	337.1802779
$W$19	< Current Level	25,956	0	1500326.158	1E+30	1474370.158
$C$21	Lower Bound Full	150,000	-3	0	7178.67616	336066.9738
$D$21	Lower Bound Heavy	150,000	-3	0	5974.622478	281644.836
$E$21	Lower Bound "LITE"	250,000	0	0	1E+30	622616.1644
$F$21	Lower Bound Full	500,000	-1	0	273790.0956	29057.26958
$G$21	Lower Bound Light	250,000	-1	0	281479.599	8724.507982
$H$21	Lower Bound Heavy	250,000	-1	0	8261.525925	273847.2525
$I$21	Lower Bound Naphtha	125,000	0	0	1E+30	149029.2793

$J$21	Lower Bound Imported	292,500	-1	0	707439.4266	71958.14147
$K$21	Lower Bound Imported	122,500	-1	0	16668.19658	227500
$L$21	Lower Bound Alky-Poly	625,000	0	0	1E+30	6169.344933
$M$21	Lower Bound ETOH	25,956	-21	0	2102.667409	17182.64793
$N$21	Lower Bound MTBE	201,488	0	0	1E+30	32099.45218
$O$21	Lower Bound Imported	93,750	-1	0	169388.0478	32099.45218
$P$21	Lower Bound ETBE	0	-1	0	196359.8997	12676.5215
$Q$21	Lower Bound N-butane	0	0	0	1E+30	213415.7202
$R$21	Lower Bound Xylene	0	0	0	1E+30	49094.9128
$S$21	Lower Bound & Cnap	0	0	0	1E+30	217381.6262
$C$22	Upper Bound Full	2,250,000	0	0	2100000	1E+30
$D$22	Upper Bound Heavy	500,000	0	0	350000	1E+30
$E$22	Upper Bound "LITE"	1,500,000	0	0	627383.8356	1E+30
$F$22	Upper Bound Full	1,750,000	0	0	1250000	1E+30
$G$22	Upper Bound Light	800,000	0	0	550000	1E+30
$H$22	Upper Bound Heavy	975,000	0	0	725000	1E+30
$I$22	Upper Bound Naphtha	1,904,772	0	0	1630743.158	1E+30
$J$22	Upper Bound Imported	450,000	0	0	157500	1E+30
$K$22	Upper Bound Imported	350,000	0	0	227500	1E+30
$L$22	Upper Bound Alky-Poly	1,532,486	0	0	901316.9051	1E+30
$M$22	Upper Bound ETOH	150,033	0	0	124076.6158	1E+30
$N$22	Upper Bound MTBE	402,975	0	0	169388.0478	1E+30
$O$22	Upper Bound Imported	375,000	0	0	281250	1E+30
$P$22	Upper Bound ETBE	124,077	0	0	124076.6158	1E+30
$Q$22	Upper Bound N-butane	250,000	0	0	36584.27983	1E+30
$R$22	Upper Bound Xylene	75,000	0	0	25905.0872	1E+30
$S$22	Upper Bound & Cnap	217382	4	0	198489.3473	6106.318177

Catalytic Cracking and Hydrocracking

	FCCU - VGO			FCCU - HGO		Hydrocracker - VGO		r		- HGO
	Dist	Mogas	Hi-Sev	Dist	Mogas	Hi-Sev	Dist	Nap	RES	Dist
	9.24	8.64	6.88	9.40	8.94	7.16	16.49	9.04	7.39	16.86
Naphtha	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.08	0.10	0.15
LCO	0.54	0.21	0.16	0.54	0.21	0.16	-0.25	-0.25	0.00	-0.25
Distillate	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.65	0.94
C4	0.12	0.17	0.22	0.12	0.17	0.22	0.03	0.21	0.03	0.03
FCCN	0.32	0.59	0.55	0.32	0.59	0.55	0.00	0.00	0.00	0.00
FCCU Cap	1	1	1	1	1	1	0	0	0	0
H-C Cap	0	0	0	0	0	0	1	1	1	1
HOC Cap	0	0	0	0	0	0	0	0	0	0
H-Oil Feed	0	0	0	0	0	0	0	0	0	0
Ares Feed	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	0.000	0.000	-0.800	0.000
VRES Feed	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.250	-0.250	-0.200	0.000
VGO Feed	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750	-0.750	0.000	0.000
HGO Feed	0.000	0.000	0.000	-0.650	-0.650	-0.650	0.000	0.000	0.000	-0.750
LB	0	0	0	0	0	0	50000	0	50000	50000
UB	1350000	2700000	1782000	1350000	1350000	810000	604505	201502	403003	161201
Solution	1350000	0	657450	1350000	0	0	405337	0	195683	50000

$40,915,277

Output	b/d
Naphtha	217382
Light Hydrocrackate	108691
LCO	1421526
Distillate	601336
Butane & C4	524777
FCCN	1267314
Ares	-828037
Vres	-672213

Capacity Utilization	
FCCU	62.17%
Hydrocracker	94.58%
HOC	50.00%

Nap	HOC Nap	HOC Dist		Constraint
8.67	10.62	11.67		Constraint
1.08	0.12	0.07	>	217,382
-0.25	0.00	0.00	>	250,000
0.00	0.23	0.47	>	601,336
0.21	0.17	0.08	>	524,777
0.00	0.48	0.35	>	1,000,000
0	0.00	0.00	<	5,400,000
1	0.00	0.00	<	806,006
0	1.00	1.00	<	225,000
0	-0.750	-0.750	>	-112,500
0.000	0.000	0.000	>	-828,037
0.000	-0.250	-0.250	>	-673,393
0.000	0.000	0.000	>	-1,784,879
-0.750	0.000	0.000	>	-2,053,612
0	28125	28125		
161201	140625	84375		11,098,412
111325	28125	84375		4,232,296

4.0 Answer Report
ı-5.XLW]DISTC1.XLS
ıd: 8/31/92 17:15

Target Cell (Min)

Cell	Name	Original Value	Final Value
$A$55	Solution	$40,915,288	$40,915,277

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$54	Solution Dist	1350000	1350000
$D$54	Solution Mogas	0	0
$E$54	Solution Hi-Sev	657450	657450
$F$54	Solution Dist	1350000	1350000
$G$54	Solution Mogas	0	0
$H$54	Solution Hi-Sev	0	0
$I$54	Solution Dist	405337	405337
$J$54	Solution Nap	0	0
$K$54	Solution RES	195684	195683
$L$54	Solution Dist	50000	50000
$M$54	Solution Nap	111325	111325
$N$54	Solution Nap	28125	28125
$O$54	Solution Dist	84375	84375

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$U$37	Naphtha Calculated Level	217,382	$U$37>=$Q$37	Binding	0
$U$38	LCO Calculated Level	1,421,526	$U$38>=$Q$38	Not Binding	1,171,526
$U$39	Distillate & Jet Calculated Level	601,336	$U$39>=$Q$39	Not Binding	601,336
$U$40	Butane & C4 Calculated Level	524,777	$U$40>=$Q$40	Binding	0
$U$41	FCCN Calculated Level	1,267,314	$U$41>=$Q$41	Not Binding	267,314
$U$42	FCCU Cap Calculated Level	3,357,450	$U$42<=$Q$42	Not Binding	2,042,550
$U$43	H-C Cap Calculated Level	762,346	$U$43<=$Q$43	Not Binding	43,660
$U$44	HOC Cap Calculated Level	112,500	$U$44<=$Q$44	Not Binding	112,500
$U$45	H-Oil Feed Calculated Level	-84,375	$U$45>=$Q$45	Not Binding	28,125
$U$46	Ares Feed Calculated Level	-828,037	$U$46>=$Q$46	Binding	0
$U$47	VRES Feed Calculated Level	-672,213	$U$47>=$Q$47	Not Binding	1,180
$U$48	VGO Feed Calculated Level	-1,608,845	$U$48>=$Q$48	Not Binding	176,033
$U$49	HGO Feed Calculated Level	-998,494	$U$49>=$Q$49	Not Binding	1,055,118
$C$52	UB Dist	1350000	$C$52>=$C$54	Not Binding	1350000
$D$52	UB Mogas	2700000	$D$52>=$D$54	Not Binding	2700000
$E$52	UB Hi-Sev	1782000	$E$52>=$E$54	Not Binding	467100
$F$52	UB Dist	1350000	$F$52>=$F$54	Not Binding	1350000
$G$52	UB Mogas	1350000	$G$52>=$G$54	Not Binding	1350000
$H$52	UB Hi-Sev	810000	$H$52>=$H$54	Not Binding	810000
$I$52	UB Dist	604505	$I$52>=$I$54	Not Binding	206169

$J$52	UB Nap	201502	$J$52>=$J$54	Not Binding	201502
$K$52	UB RES	403003	$K$52>=$K$54	Not Binding	11636
$L$52	UB Dist	161201	$L$52>=$L$54	Not Binding	61201
$M$52	UB Nap	161201	$M$52>=$M$54	Not Binding	61450
$N$52	UB Nap	140625	$N$52>=$N$54	Not Binding	84375
$O$52	UB Dist	84375	$O$52>=$O$54	Not Binding	84375
$C$54	Solution Dist	1350000	$C$54>=$C$51	Not Binding	1350000
$D$54	Solution Mogas	0	$D$54>=$D$51	Binding	0
$E$54	Solution Hi-Sev	657450	$E$54>=$E$51	Not Binding	657450
$F$54	Solution Dist	1350000	$F$54>=$F$51	Not Binding	1350000
$G$54	Solution Mogas	0	$G$54>=$G$51	Binding	0
$H$54	Solution Hi-Sev	0	$H$54>=$H$51	Binding	0
$I$54	Solution Dist	405337	$I$54>=$I$51	Not Binding	355337
$J$54	Solution Nap	0	$J$54>=$J$51	Binding	0
$K$54	Solution RES	195683	$K$54>=$K$51	Not Binding	145683
$L$54	Solution Dist	50000	$L$54>=$L$51	Binding	0
$M$54	Solution Nap	111325	$M$54>=$M$51	Not Binding	111325
$N$54	Solution Nap	28125	$N$54>=$N$51	Binding	0
$O$54	Solution Dist	84375	$O$54>=$O$51	Not Binding	56250

.0 Sensitivity Report
-5.XLW]DISTC1.XLS
d: 8/31/92 17:15

Changing Cells

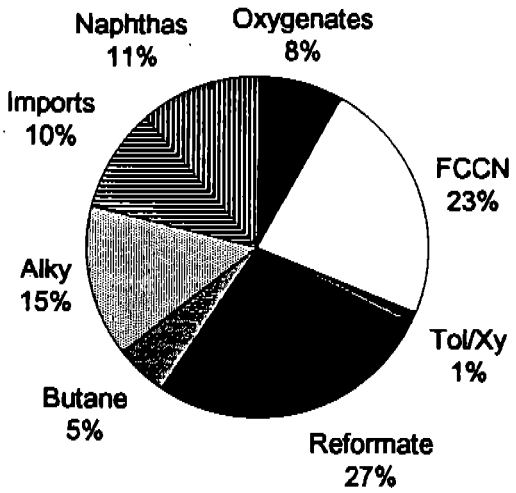
Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$54	Solution Dist	1350000	0	9.241730754	3.138507057	1E+30
$D$54	Solution Mogas	0	2	8.642300963	1E+30	1.967665969
$E$54	Solution Hi-Sev	657450	0	6.882259642	0.274000654	2.618952757
$F$54	Solution Dist	1350000	0	9.401730754	2.978507057	1E+30
$G$54	Solution Mogas	0	2	8.937269449	1E+30	2.262645744
$H$54	Solution Hi-Sev	0	0	7.156260312	1E+30	0.274000604
$I$54	Solution Dist	405337	0	16.49206725	0.365850001	1.179140658
$J$54	Solution Nap	0	0	9.03904438	1E+30	0.365828286
$K$54	Solution RES	195683	0	7.38682125	7.707415567	4.205572936
$L$54	Solution Dist	50000	0	16.85791725	1E+30	0.365850001
$M$54	Solution Nap	111325	0	8.6732235	0.365828317	9.397717472
$N$54	Solution Nap	28125	1	10.62305438	1E+30	0.686838263
$O$54	Solution Dist	84375	0	11.6659967	0.795158969	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$U$37	Naphtha Calculated Level	217,382	8	217381.6262	31323.93863	102025.3398
$U$38	LCO Calculated Level	1,421,526	0	250000	1171526.364	1E+30
$U$39	Distillate & Jet Calculated L	601,336	21	0	3415.149467	257511.1253
$U$40	Butane & C4 Calculated Le	524,777	24	524776.7921	2554.039302	44805.1274
$U$41	FCCN Calculated Level	1,267,314	0	1000000	267313.8196	1E+30
$U$42	FCCU Cap Calculated Leve	3,357,450	0	5400000	1E+30	2042550.056
$U$43	H-C Cap Calculated Level	762,346	0	806006.25	1E+30	43660.28832
$U$44	HOC Cap Calculated Level	112,500	0	225000	1E+30	112500
$U$45	H-Oil Feed Calculated Leve	-84,375	0	-112500	28125	1E+30
$U$46	Ares Feed Calculated Level	-828,037	10	-828036.75	27030.25505	164772.5221
$U$47	VRES Feed Calculated Lev	-672,213	0	-673393.1118	1179.661072	1E+30
$U$48	VGO Feed Calculated Leve	-1,608,845	0	-1784878.606	176033.3355	1E+30
$U$49	HGO Feed Calculated Leve	-998,494	0	-2053612.4	1055118.324	1E+30
$C$52	UB Dist	1350000	3	0	14174.52321	601951.9357
$D$52	UB Mogas	2700000	0	0	2700000	1E+30
$E$52	UB Hi-Sev	1782000	0	0	1124550.056	1E+30
$F$52	UB Dist	1350000	3	0	14174.52321	601951.9357
$G$52	UB Mogas	1350000	0	0	1350000	1E+30
$H$52	UB Hi-Sev	810000	0	0	810000	1E+30
$I$52	UB Dist	604505	0	0	199167.6122	1E+30
$J$52	UB Nap	201502	0	0	201501.5625	1E+30
$K$52	UB RES	403003	0	0	207319.6736	1E+30
$L$52	UB Dist	161201	0	0	111201.25	1E+30
$M$52	UB Nap	161201	0	0	49875.81501	1E+30

$N$52 UB Nap	140625	0	0	112500	1E+30
$O$52 UB Dist	84375	1	0	56250	23108.12362

Gasoline Composition



ANNEX 2

SENSITIVITY ANALYSES

FOR ETHANOL AT

90¢ AND 60¢

PER GALLON

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 9/22/92 14:15

Target Cell (Min)

Cell	Name	Original Value	Final Value
$D$25	Objective Function He	1.285E+08	1.285E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	150000	150000
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	463411	463428
$F$27	Variables Full	500000	500000
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	556089	556073
$I$27	Variables Naphtha	303988	303977
$J$27	Variables Imported	292500	292500
$K$27	Variables Imported	122500	122500
$L$27	Variables Alky-Poly	625000	625000
$M$27	Variables ETOH	25956	25956
$N$27	Variables MTBE	201487	201488
$O$27	Variables Imported	93750	93750
$P$27	Variables ETBE	124077	124077
$Q$27	Variables N-butane	247054	247055
$R$27	Variables Xylene	2811	2816
$S$27	Variables & Cnap	217382	217382

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	4,326,000	$V$7<=$W$7	Not Binding	4,326,000
$W$8	< Current Level	4,326,000	$W$8<=$V$8	Not Binding	1,081,500
$W$9	< Current Level	2,307,161	$W$9<=$V$9	Not Binding	3,092,839
$W$10	< Current Level	967,283	$W$10<=$V$10	Not Binding	3,032,717
$W$11	< Current Level	441,780	$W$11<=$V$11	Not Binding	27,303
$W$12	< Current Level	1,081,500	$W$12<=$V$12	Binding	0
$W$13	> Current Level	90,338	$W$13>=$V$13	Not Binding	13,638
$W$14	> Current Level	372,967,513	$W$14>=$V$14	Not Binding	355,246,345
$W$15	> Current Level	410,970,000	$W$15>=$V$15	Not Binding	410,970,000
$W$16	< Current Level	45,423,000	$W$16<=$V$16	Binding	0
$W$17	< Current Level	962,385	$W$17<=$V$17	Not Binding	777,440
$W$18	< Current Level	43,260	$W$18<=$V$18	Binding	0
$W$19	< Current Level	78,646	$W$19<=$V$19	Not Binding	1,421,680
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	150,000
$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	676,856

$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	500,000
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	862,145
$I$21	Lower Bound Naphtha	125,000	$I$21<=$I$27	Not Binding	482,954
$J$21	Lower Bound Imported	292,500	$J$21<=$J$27	Not Binding	292,500
$K$21	Lower Bound Imported	122,500	$K$21<=$K$27	Not Binding	122,500
$L$21	Lower Bound Alky-Poh	625,000	$L$21<=$L$27	Not Binding	625,000
$M$21	Lower Bound ETOH	25,956	$M$21<=$M$27	Not Binding	25,956
$N$21	Lower Bound MTBE	201,488	$N$21<=$N$27	Not Binding	201,488
$O$21	Lower Bound Imported	93,750	$O$21<=$O$27	Not Binding	93,750
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Not Binding	248,153
$Q$21	Lower Bound N-butane	0	$Q$21<=$Q$27	Not Binding	494,109
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Not Binding	5,632
$S$21	Lower Bound & Cnap	0	$S$21<=$S$27	Not Binding	434,763
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	1,950,000
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,500,000	$E$22>=$E$27	Not Binding	573,144
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	750,000
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	137,145
$I$22	Upper Bound Naphtha	1,904,772	$I$22>=$I$27	Not Binding	1,296,818
$J$22	Upper Bound Imported	450,000	$J$22>=$J$27	Not Binding	135,000
$K$22	Upper Bound Imported	350,000	$K$22>=$K$27	Not Binding	105,000
$L$22	Upper Bound Alky-Poh	1,532,486	$L$22>=$L$27	Not Binding	282,486
$M$22	Upper Bound ETOH	150,033	$M$22>=$M$27	Not Binding	98,121
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Binding	0
$O$22	Upper Bound Imported	375,000	$O$22>=$O$27	Not Binding	187,500
$P$22	Upper Bound ETBE	124,077	$P$22>=$P$27	Not Binding	124,077
$Q$22	Upper Bound N-butane	250,000	$Q$22>=$Q$27	Not Binding	244,109
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	69,368
$S$22	Upper Bound & Cnap	217382	$S$22>=$S$27	Not Binding	217382

Microsoft Excel 4.0 Answer Report
Worksheet: [PADD-5.XLW]SUMEXPC1.XLS
Report Created: 9/22/92 16:06

Target Cell (Min)

Cell	Name	Original Vali	Final Value
$D$25	Objective Function He:	1.272E+08	1.272E+08

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$27	Variables Full	150000	150000
$D$27	Variables Heavy	150000	150000
$E$27	Variables "LITE"	294936	294936
$F$27	Variables Full	500000	500000
$G$27	Variables Light	250000	250000
$H$27	Variables Heavy	581991	581991
$I$27	Variables Naphtha	367746	367746
$J$27	Variables Imported	292500	292500
$K$27	Variables Imported	122500	122500
$L$27	Variables Alky-Poly	625000	625000
$M$27	Variables ETOH	150033	150033
$N$27	Variables MTBE	201488	201488
$O$27	Variables Imported	93750	93750
$P$27	Variables ETBE	124077	124077
$Q$27	Variables N-butane	204599	204599
$R$27	Variables Xylene	0	0
$S$27	Variables & Cnap	217382	217382

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$V$7	> Level	4,326,000	$V$7<=$W$7	Not Binding	4,326,000
$W$8	< Current Level	4,326,000	$W$8<=$V$8	Not Binding	1,081,500
$W$9	< Current Level	2,349,477	$W$9<=$V$9	Not Binding	3,050,523
$W$10	< Current Level	771,569	$W$10<=$V$10	Not Binding	3,228,431
$W$11	< Current Level	438,588	$W$11<=$V$11	Not Binding	30,494
$W$12	< Current Level	1,038,790	$W$12<=$V$12	Not Binding	42,710
$W$13	> Current Level	132,524	$W$13>=$V$13	Not Binding	55,824
$W$14	> Current Level	372,362,625	$W$14>=$V$14	Not Binding	355,851,233
$W$15	> Current Level	410,970,000	$W$15>=$V$15	Not Binding	410,970,000
$W$16	< Current Level	45,423,000	$W$16<=$V$16	Binding	0
$W$17	< Current Level	962,385	$W$17<=$V$17	Not Binding	806,778
$W$18	< Current Level	43,260	$W$18<=$V$18	Binding	0
$W$19	< Current Level	202,723	$W$19<=$V$19	Not Binding	1,297,603
$C$21	Lower Bound Full	150,000	$C$21<=$C$27	Not Binding	150,000

$D$21	Lower Bound Heavy	150,000	$D$21<=$D$27	Not Binding	150,000
$E$21	Lower Bound "LITE"	250,000	$E$21<=$E$27	Not Binding	339,872
$F$21	Lower Bound Full	500,000	$F$21<=$F$27	Not Binding	500,000
$G$21	Lower Bound Light	250,000	$G$21<=$G$27	Not Binding	250,000
$H$21	Lower Bound Heavy	250,000	$H$21<=$H$27	Not Binding	913,982
$I$21	Lower Bound Naphtha	125,000	$I$21<=$I$27	Not Binding	610,491
$J$21	Lower Bound Imported	292,500	$J$21<=$J$27	Not Binding	292,500
$K$21	Lower Bound Imported	122,500	$K$21<=$K$27	Not Binding	122,500
$L$21	Lower Bound Alky-Poh	625,000	$L$21<=$L$27	Not Binding	625,000
$M$21	Lower Bound ETOH	25,956	$M$21<=$M$27	Not Binding	274,109
$N$21	Lower Bound MTBE	201,488	$N$21<=$N$27	Not Binding	201,488
$O$21	Lower Bound Imported	93,750	$O$21<=$O$27	Not Binding	93,750
$P$21	Lower Bound ETBE	0	$P$21<=$P$27	Not Binding	248,153
$Q$21	Lower Bound N-butane	0	$Q$21<=$Q$27	Not Binding	409,198
$R$21	Lower Bound Xylene	0	$R$21<=$R$27	Binding	0
$S$21	Lower Bound & Cnap	0	$S$21<=$S$27	Not Binding	434,763
$C$22	Upper Bound Full	2,250,000	$C$22>=$C$27	Not Binding	1,950,000
$D$22	Upper Bound Heavy	500,000	$D$22>=$D$27	Not Binding	200,000
$E$22	Upper Bound "LITE"	1,500,000	$E$22>=$E$27	Not Binding	910,128
$F$22	Upper Bound Full	1,750,000	$F$22>=$F$27	Not Binding	750,000
$G$22	Upper Bound Light	800,000	$G$22>=$G$27	Not Binding	300,000
$H$22	Upper Bound Heavy	975,000	$H$22>=$H$27	Not Binding	188,982
$I$22	Upper Bound Naphtha	1,904,772	$I$22>=$I$27	Not Binding	1,169,281
$J$22	Upper Bound Imported	450,000	$J$22>=$J$27	Not Binding	135,000
$K$22	Upper Bound Imported	350,000	$K$22>=$K$27	Not Binding	105,000
$L$22	Upper Bound Alky-Poh	1,532,486	$L$22>=$L$27	Not Binding	282,486
$M$22	Upper Bound ETOH	150,033	$M$22>=$M$27	Not Binding	150,033
$N$22	Upper Bound MTBE	402,975	$N$22>=$N$27	Binding	0
$O$22	Upper Bound Imported	375,000	$O$22>=$O$27	Not Binding	187,500
$P$22	Upper Bound ETBE	124,077	$P$22>=$P$27	Not Binding	124,077
$Q$22	Upper Bound N-butane	250,000	$Q$22>=$Q$27	Not Binding	159,198
$R$22	Upper Bound Xylene	75,000	$R$22>=$R$27	Not Binding	75,000
$S$22	Upper Bound & Cnap	217382	$S$22>=$S$27	Not Binding	217382