BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Emergency Allocation Rules Fail To Recognize Needs Of Petrochemical Industry

The petrochemical industry uses petroleum and natural gas for making its products as well as meeting its fuel needs. However, current Government allocation programs pertain solely to fuel uses, not to the industry's material feedstock requirements.

Failure to recognize the feedstock requirements could result in supply constrictions with a disproportionate impact on the industry.

At this time, it is difficult to assess the feedstock requirements of the petrochemical industry because the Government lacks a definition of the industry itself, and what data it has is insufficient to provide a basis for an effective allocation program. GAO recommends a number of actions to overcome these Department of Energy deficiencies.

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COMPTROLLER GENERAL OF THE UNITED STATES
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To the President of the Senate and the
Speaker of the House of Representatives

This report presents the petrochemical industry's need for a petroleum and natural gas feedstock allocation program. The problem at this time is that the Department of Energy allocates these hydrocarbons only as fuels and not as material feedstocks needed to produce intermediate and end-use products.

We developed this report to inform the Congress of the importance of a feedstock allocation program and to stress the need for an adequate data system to support such an allocation policy.

We are sending copies of this report to the Director, Office of Management and Budget; the Secretaries of Energy and Commerce; and to the Chairman, International Trade Commission.

Comptroller General
of the United States

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COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

EMERGENCY ALLOCATION RULES FAIL TO RECOGNIZE NEEDS OF PETROCHEMICAL INDUSTRY

D I G E S T

The petrochemical industry plays a critical role in the Nation's economy, comparable to that of the metals industry. Unlike other U.S. materials industries, the petrochemical industry has been growing rapidly. However, future petrochemical growth could be subject to severe constraints as a result of constricted supplies of petroleum and natural gas.

The petrochemical industry's basic feedstocks--natural gas, natural gas liquids, and petroleum liquids--also have valuable energy uses. Therefore, the petrochemical industry must compete for its feedstocks with virtually the entire economy. This is in contrast to the metals industries that are the sole consumers of their feedstocks (e.g., iron ore, bauxite).

Future supplies of crude oil, natural gas liquids, and natural gas will probably be constricted, resulting in increasing competition between the various segments of the economy. This competition could become particularly intense as a result of the Government imposed import limit on petroleum to 8.5 million barrels a day and the fact that future petrochemical growth becomes increasingly dependent on oil-based feedstocks.

Current Government allocation programs are based on fuel uses, not feedstock uses. Failure to recognize the hydrocarbon raw material feedstock requirements of the petrochemical industry could result in supply constrictions having a disproportionate impact on the

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petrochemical industry. This report provides a perspective within which any allocation system or supply policy could be developed to recognize the important differences between fuel and feedstock uses of an energy resource by the petrochemical industry. Such systems or policies would provide for an equitable distribution of any shortfalls of petroleum and natural gas among all industrial users.

PETROCHEMICAL PERSPECTIVES

The petrochemical industry has evolved from "an energy junkman" using by-products/wastes of energy production to a multibillion dollar industry. Low material costs helped these products find ready markets as substitutes for such traditional materials as natural fibers and packaging materials. Today, the industry uses basic energy sources as feedstocks to make products that are finding major new markets in housing construction, industrial applications, and automobile manufacture.

Energy Use

Although petrochemical feedstocks account for only 3.3 percent of U.S. consumption of crude oil and 2.7 percent of natural gas consumption, they account for 21.0 percent of all natural gas liquids consumption. Almost all new petrochemical plants are based on heavy crude fractions, mainly naphtha and gas oil, as a result of the industry's attempt to secure long-term supplies of feedstock in the face of what it once believed to be declining domestic availability of natural gas and natural gas liquids. However, as Government policy moves toward limiting crude oil imports, the hoped-for, long-term supply of crude may not be there.

Under normal market conditions, the high value added of petrochemical products would probably give the industry an advantage over other users

of crude oil. But, if confronted with the current Department of Energy philosophy of equally distributing shortages across the board, the petrochemical industry could be more affected than other industrial users. The current allocation systems simply do not distinguish between fuel and feedstock consumption and, thus, do not provide for an "equitable" distribution of economic losses as a result of energy shortfalls.

A Government allocation program that recognizes material feedstock uses of crude oil and natural gas in the face of constricted supplies would appear to have little impact on fuel needs outside the industry, even if the allocation were made at 100 percent of "demand." However, an allocation of 100 percent of natural gas liquids feedstock needs would significantly affect availability of natural gas liquids for other users, probably making equitable allocation of natural gas liquids more difficult than allocating crude oil or natural gas. Thus, any major allocation schemes should focus first on the use of natural gas liquids.

Petrochemical Markets

The petrochemical industry's growth came from three sources: (1) overall economic growth; (2) displacement of existing products; e.g., chemical fibers for natural fibers in clothes; and (3) development of new markets. Today many displacement markets have been saturated; growth in these markets will slow down to the growth in the overall economy. Any future rapid growth in the industry will depend on the development of new displacement markets. The feedstock requirements and energy use for such new markets could significantly differ from previous experience. Any Government information system on feedstock requirements will have to possess comparable information on petrochemical markets.

GOVERNMENT PETROCHEMICAL INFORMATION

The Government presently cannot distinguish between fuel and feedstock uses of petroleum and natural gas. Current information systems on the petrochemical industry are dispersed among numerous agencies. The information that exists is not uniform and is often outdated by the time it is published. It does not contain data on inventory or feedstocks. There are no Standard Industry Classification codes for the petrochemical industry in the Commerce Department's statistical system. The lack of a uniform definition of the industry results in widely varying definitions which confuse the collection of such basic data as the industry's total consumption of energy. As a result, it sometimes seems as though there are as many petrochemical industries as analysts.

The Government's data base is patently deficient relative to either emergency or chronic shortages that could necessitate allocation decisions.

CONCLUSIONS

Current Government allocation policies and possible chronic problems of fuels availability indicate a strong need for a revamped information system, if petroleum and natural gas shortfalls are not to affect the petrochemical industry disproportionately. Such a revamped information system should recognize the following facts:

--While feedstock uses of crude and natural gas are quite small relative to overall use (2 to 3 percent), the feedstock uses of natural gas liquids represent a major share (21 percent) of the overall natural gas liquids used.

--Feedstock usage is beginning to change as the petrochemical industry switches from natural gas to crude derived feedstocks.

--A good feedstock allocation information system should provide information on (1) current levels of consumption, (2) trends in these

levels, and (3) alternate feedstocks which could be used.

--The system must provide for comparability of data resulting from a uniform definition of the industry.

--The level of detail must be sufficient to reveal trends but should not be greater than that which can be prepared accurately by the industry and required by expected users.

--Initial priority should be given to developing timely and accurate data in general before developing any extensive detail.

--Because of the large share of available natural gas liquids used as petrochemical feedstocks, attention should be focused first on the problems of developing an allocation system for, and information on, the consumption patterns of all natural gas liquid users.

--The required level of detail on energy/feedstock use and economic roles of the petrochemical industry will depend on the extent to which adjustments in initial allocations by participants are precluded. The more rigid the allocation system, the more detailed the data would have to be. GAO considers that economic efficiency would be more likely under a system permitting adjustment within broad governmental allocation rules. A complex system of detailed allocations that attempts to respond to rapidly changing market needs is not desirable.

RECOMMENDATIONS

--The Secretary of Energy, working in collaboration with the Secretary of Commerce, should establish a standardized definition of the petrochemical industry suitable for allocation purposes. The definition, and the

rationale supporting it, should be provided to the Congress not later than 6 months from release of this report.

--The Department of Energy should define information requirements necessary to support timely allocations of petroleum, natural gas, and natural gas liquid feedstocks, if conditions necessitate direct Government apportionment of supplies. The allocation system should recognize industry's needs for both energy and feedstock requirements. Special attention should be given to allocation procedures for natural gas liquids.

--As part of his report to the Congress, the Secretary of Energy should explain the rationale for anticipated standby allocation procedures including an examination of alternatives for maintaining as much market flexibility as possible.

--Within 1 year following issuance of this report, the Department of Energy should submit to the Office of Management and Budget, and the Congress, its recommendations for medium to long-term phasing out of any data systems that might overlap or be duplicated by the required new system. However, both the new and present systems should be maintained for a sufficient period of time to retain the information on trends in the petrochemical industry. (See pp. 25 and 26.)

AGENCY COMMENTS

Agency comments were received from the Department of Energy, International Trade Commission, and the Department of Commerce. They generally agreed that a standardized definition of the petrochemical industry, an adequate information system to support a feedstock allocation program, and an allocation system that recognizes the feedstock needs of the petrochemical industry are urgently required.

All agencies recognized GAO's major report premise that if a petrochemical feedstock allocation is not established, a future petroleum shortage could precipitate a serious feedstock shortage; and that a timely and adequate data base is a prerequisite to establishing any feedstock allocation program. (See pp. 26 and 27.)

Contents

ABBREVIATIONS

DOC	Department of Commerce
DOE	Department of Energy
DOI	Department of Interior
DOL	Department of Labor
EIA	Energy Information Administration (part of DOE)
FRB	Federal Reserve Board
FEA	Federal Energy Administration (no longer in existence)
ITC	International Trade Commission
LNG	Liquified Natural Gas
PEG	Petrochemical Energy Group
SIC	Standard Industrial Classification Code
USDA	Department of Agriculture

CHAPTER 1

INTRODUCTION

The petrochemical industry is one of the basic materials industries in the U.S. economy. Its final products play a critical role in providing for such basic human needs as food, clothing, shelter, health, and transportation. The major petrochemical products are rubber, fibers, agricultural chemicals, and plastics. For example, almost 80 percent of the Nation's rubber is made from petrochemicals. Petrochemical-based fibers account for almost half of the fibers used in clothing. Agricultural chemicals, such as fertilizers and pesticides, have been the key to increased U.S. food production, and plastics play a vital role in our communications, transportation, and housing industries. Lastly, without petrochemicals many modern drugs of modern medicine, for example, aspirin and penicillin, would not exist.

The petrochemical industry is a critical sector of the domestic economy comparable to that of steel. In 1978 petrochemical production employed 413,000 people; derivatives employ a large percentage of the remaining 681,000 people in the chemical and allied products industry. Steel in comparison employs 610,000, and aluminum 130,000. The value added of the chemical sector per se (1977) was $31 billion, 5 percent greater than the entire metals sector. As for investment, last year $8.6 billion was invested in chemicals as opposed to $5.9 billion in all phases of metal production.

Furthermore, unlike many U.S. material industries, the petrochemical industry has been growing rapidly. While this growth rate will probably decrease in the future, the petrochemical industry could remain one of the fastest-growing materials industries. However, the future of the petrochemical industry is dependent on prices and availability of adequate energy and feedstocks. And, prices are expected to increase significantly while supplies of feedstocks from conventional sources are expected to be constrained. As a result, the extent of the future growth of the petrochemical industry in the United States may be subject to severe constraints.

THE PETROCHEMICAL INDUSTRY AND ENERGY AVAILABILITY

The petrochemical industry is a unique materials industry in that its basic feedstock has valuable energy uses. Unlike other material industries, such as aluminum and steel, which

are the sole consumers of their material feedstocks (i.e., bauxite and iron ore), the petrochemical industry must compete for its feedstock with virtually the entire economy which uses hydrocarbons as fuel.

Feedstock for the U.S. petrochemical industry has historically been largely based on natural gas and natural gas liquids. The industry developed around, and became dependent on, natural gas because it was a cheap, plentiful source of feedstock. Today, to a large extent, the petrochemical industry depends upon natural gas and natural gas liquids for feedstock. However, almost all petrochemical plants under construction or proposed are designed to use heavier feedstocks, for example, naphtha, gas oil, and other petroleum fractions. This is because the petrochemical industry, given the prevailing views of the natural gas resource base and of governmental regulatory policies, believed that natural gas supplies would be less available than crude oil. Circumstances have changed since those construction decisions were made. Future U.S. supplies of both petroleum and natural gas are now expected to be constricted.

U.S. petroleum production has been declining, and the decline is expected to continue. The recent Government announcement to hold petroleum imports to 8.5 million barrels a day, in light of declining domestic production, indicates that the total availability of petroleum in the United States will decline until such alternatives such as synthetic liquids from coal and oil shale might be able to counteract the decline in domestic production. This will probably not occur until the 1990s at the most optimistic estimate and more likely not until the next century. Thus, the U.S. economy in general and the petrochemical industry in particular will experience growing competition for a shrinking petroleum supply, at least through the 1980s, should the import limitation be maintained.

The natural gas picture is better but is also subject to a significant amount of uncertainty. Domestic supplies from conventional sources will probably continue to decline. While such unconventional sources as Western tar sands and Devonian shales might counteract much or all of this decline, many technical obstacles stand in the way of significant production from these sources.

Natural gas imports have growth prospects but are also subject to considerable uncertainties. The U.S. policy on liquified natural gas (LNG) imports is neutral at best and probably somewhat negative. Although Canada and Mexico have natural gas for export, the long-term availability of significant amounts of natural gas from either source is somewhat problematic.

Declining petroleum supplies and uncertain growth prospects in natural gas supplies pose serious problems for the petrochemical industry, since future growth in capacity is primarily based on oil-based feedstocks. Any petroleum or natural gas supply shortfalls could more directly affect petrochemical output than they would other material industries that use these resources solely as fuels. For example, the steel industry has some degree of flexibility to adjust for shortfalls in energy supply. But shortfalls in petroleum or natural gas for the petrochemical industry could translate directly into losses of material feedstock and hence material output since substitution possibilities are drastically limited by the technologies used. Therefore, allocations of petroleum or natural gas shortfalls across the board on an energy basis for all industries, without taking into account the feedstock needs of the petrochemical industry, would increase the impact of any shortfall on the petrochemical industry disproportionate to other industries.

Such a situation occurred in 1973-1974 when the Arab embargo limited the supply of crude oil and, therefore, the availability of liquid feedstock needed by the petrochemical industry. In regulations enacted in January 1974, the Government began to allocate crude oil and the liquid hydrocarbon feedstocks used in the petrochemical industry. The allocation of crude oil reduced crude supplies to some refineries able to produce petrochemical feedstocks and gave these supplies to other refineries without that ability. The supply of one petrochemical, ethylene, was about 6 percent less than requirements because of feedstock shortage. In other instances, plants were not given priority access to feedstock, their needs being placed subordinate to other uses, for example, residential/commercial heating and cooking. A 15- to 25-percent decrease in propylene supply during this period has been attributed to the petrochemical industry's lack of priority access to propane.

The easing of the embargo and revisions in allocation regulations around mid-1974 improved the situation for petrochemicals. However, the petrochemical shortages that were experienced affected a number of other industries--pharmaceuticals, plastics, and fibers--resulting in employee layoffs and reduced workweeks and, of course, some consumer demands were not met. Business failures have also been attributed to petrochemical shortages.

The future trends in petroleum and natural gas supplies indicate that, although severe shortages such as those experienced in 1974 may not recur, chronic and long-lasting supply difficulties can be expected. As a result, it is likely that the Government will be directly involved in allocating

available supplies among consumers differently from what freely functioning prices would accomplish.

At this point, Government allocations of energy shortfalls are based on fuel use, not feedstock use. Failure to distinguish fuel and feedstock uses could throw a disproportionate burden of any supply shortfall on the petrochemical industry. This report provides a perspective within which any allocation system or policies could be developed to recognize the important differences between fuel and feedstock uses of energy resources by the petrochemical industry.

SCOPE

During this review, we conducted interviews, reviewed records (industry and Government), and conducted literature searches.

We conducted visits to various petrochemical plants and facilities and discussed the problems and feedstock situation with both industry representatives and Government officials.

A consultant was used to insure that petrochemcial and technical integrity were maintained.

CHAPTER 2

PETROCHEMICAL INDUSTRY PERSPECTIVES

The development of more efficient refining methods in distillation and thermal cracking led to the beginning of petrochemical manufacturing during the 1920s. Before 1920 such refinery by-products as ethylene and propylene were burned off for lack of anything to do with them, as is still the case in both refining and production in many parts of the world today. In 1920 Standard Oil of New Jersey produced the first industrial petrochemical product--isopropyl alcohol--from refinery gases that formerly had been flared.

In some ways, the petrochemical industry developed as a refinery and energy waste disposal operation, much the same as paving a road with asphalt began as a utilization of an otherwise unusable crude oil remnant. The early feedstocks of the petrochemical industry were waste products, refinery gases, or products for which there were very limited markets, for example, natural gas.

From its earliest days as "something of an energy junkman," the petrochemical industry has grown to a point where it no longer takes just the by-products and wastes of energy production and refinery operations. It is now in direct competition with other energy uses for many of its material feedstocks. This chapter provides a perspective on the trends in the petrochemical industry. Specifically, the chapter

--outlines the basic framework of the petrochemical industry,

--discusses the energy feedstocks used, and

--discusses changes in the petrochemical markets.

PETROCHEMICAL FRAMEWORK

No agreement has been reached on the exact definition of petrochemicals or on the definition of the industry, but there is broad qualitative consensus. In general, petrochemicals are regarded as chemicals made from hydrocarbon fuels and various petroleum products. As a basic definition, the industry begins downstream of the crude oil refining sector and proceeds to a point short of production of consumer products.

Primary petrochemicals

Primary petrochemicals are made directly from natural gas, natural gas liquids, and crude oil fractions and are used as building blocks to produce thousands of intermediate petrochemicals. There are generally few consumer uses for "primary" petrochemicals. They include both organic (carbon-based) and inorganic chemicals. The primary organic chemicals are olefins and aromatics. Olefins include such petrochemicals as ethylene, propylene, and butadiene, while aromatics include benzene, toluene, and xylene.

About 60 percent of all ethylene supplies are converted into such intermediates as polyethylene or ethylene oxide, which become the source for such petrochemical end-products as shirts, plastic goods, and paint. Most domestic propylene is generated in refineries where about two-thirds are used in high octane gasoline blending. The largest chemical use of propylene is in polypropylene, which is made into packaging, fibers, and yarn. Butadiene is mainly used to produce synthetic rubber for tires, but it is also used in nylon, plastic, and resin production.

Catalytic reforming is used to produce a mixture of the basic aromatics from low-value, low octane refinery products. These aromatics have considerable value as a high octane gasoline blending component. If economical, however, it can be separated into benzene, toluene, and xylene. Styrene from ethylbenzene accounts for 47 percent of all benzene consumption, but, as production of unleaded gasoline increases, the petrochemical uses will face stiff competition from refiners. About 50 percent of the toluene recovered is used to produce benzene with the remainder split about equally between gasoline blending and other petrochemical manufacture. The major use of xylene is to produce intermediates, which are used in polyester fibers, films, plastics, and coatings.

The major primary inorganic petrochemicals are ammonia, hydrogen, sulfur, and carbon black. Ammonia has its largest use in the fertilizer industry, where about three-quarters of U.S. production are consumed. The remainder is used in the production of synthetic fibers, plastics, explosives, and livestock feed. Hydrogen is used in ammonia production and in refining and petrochemical processing. About 90 percent of carbon black production is used as a reinforcing filler in rubber products..

Production of the primary petrochemicals is highly concentrated in particular industry groups. Integrated petroleum refiner-petrochemical companies have over 40 percent of the total U.S. ethylene capacity, 70 percent of propylene, and 82 percent of benzene.

Intermediate Petrochemicals

Intermediate petrochemicals are derived from primary petrochemicals and are generally used in the production of finished petrochemicals. As with primary petrochemicals there are relatively few direct consumer uses of intermediate petrochemicals. Examples are ethylene glycol, phenol, ethylene oxide, vinyl chloride and styrene.

Unlike the primary petrochemicals, there is little industry concentration. No single firm produces more than a small percentage of the total output of intermediates, although the top 20 firms account for about 80 percent of the total.

PETROCHEMICAL ENERGY USE

The petrochemical industry accounts for approximately 7 percent of U.S. energy resource consumption for both fuel and feedstock uses. About 76 percent of this consumption is petroleum and natural gas. In terms of industrial energy use, the petrochemical industry is one of the largest single consumers of fuels and feedstock accounting for 22 percent of all industrial use of the petroleum and natural gas energy sources.

Fuel uses

Sixty percent of the petrochemical industry's energy consumption is for fuel purposes. The petrochemical industry has some degree of flexibility in this area to switch boiler fuels from liquid and gaseous fuels, although the flexibility for process fuels is very limited. For example, the Celanese Chemical Pumps, Pampa, Texas facility is converting from the use of natural gas as a boiler fuel to coal for both steam and electricity (co-generation) and Shell Chemical Company's initial plans were to supply steam and power to its Norco, Louisiana plant with liquid fuel and then switch to coal in 1983.

The breakdown between petrochemical fuel and feedstock use is somewhat approximate because, in the process of making petrochemicals, part of the feedstock is converted into a fuel, some of which is used in the petrochemical facility. This further obscures the separation point between feedstock and fuel.

Feedstock uses

Petrochemical feedstocks are natural gas, natural gas liquids, and petroleum liquids. While the preferred feedstocks in the United States have been natural gas and natural gas liquids because of their historical availability and low price, the largest individual source of feedstock is now petroleum liquids. In 1976 they accounted for 38 percent of the total amount of feedstock used in the U.S. petrochemical industry. A detailed breakdown of the 1976 feedstock use is shown in table 1.

Table 1
U.S. Consumption of Petrochemical Feedstocks in 1976

Feedstock	Quantity	Percent
	(millions of tons)	
Natural gas	12	22
Natural gas liquids		
Ethane	9	16
Propane	5	9
C4's and higher	5	9
Petroleum liquids		
Naptha	15	27
Gas oil	6	11
Indirect olefins	3	6
Total	55	100

In 1976 petrochemical feedstocks accounted for 3.3 percent of natural gas consumption, 2.7 percent of crude oil consumption, and 21.0 percent of natural gas liquids consumption. The petrochemical feedstocks account for a very small portion of crude oil and natural gas consumption in the United States. Thus, despite the economic importance of these feedstocks, such small proportions could easily be lost in an overall assessment of crude oil and natural gas use, particularly when this assessment is based on energy use, not feedstock material use.

Beginning in the mid-1970's, a growing trend has occurred towards chemical plants based on heavy crude fractions,

mainly naphtha and gas oil. One analysis estimates that this trend could continue at a pace such that, by 1990, crude oil would provide 60 percent of current feedstock needs compared to today's 37 percent. Of the 12 new world-scale olefins plants under construction in the Gulf Coast, only 1 is based on natural gas liquids; the rest are based on crude oil.

A major reason for the switch to heavy crude oil fractions was their expected ready availability compared to natural gas or natural gas liquids. In general, the industry expected that the declining domestic production of these, coupled with limited prospects for natural gas imports, indicated that shortages in these fuels could be chronic and long-lasting. Higher priority users such as residential users of natural gas and agricultural users of propane, would displace petrochemical facilities that were in lower priority industrial use categories. For example, one company decided to use crude fractions as feedstock for its olefin plant not so much on the basis of then-current economics as the fact that it did not believe there would be a secure, long-term supply of ethane or propane from domestic or foreign sources.

Ironically, the recently announced Government policies to curtail petroleum imports could now create chronic shortages of crude. Thus the switch to heavy crude fractions will probably provide the industry with little more protection from feedstock shortages than had it stayed with natural gas liquids and natural gas.

PETROCHEMICAL MARKETS

The petrochemical industry underwent an almost explosive growth rate from 1960-73. During this period, when ethylene production increased at an annual growth rate of 11.5 percent and vinyl chloride at 14.1 percent, its growth far outstripped the growth in the economy. This was because petrochemical growth came from three different sources

--growth due to displacement of existing products;

--growth due to entirely new uses; and

--since introduction of rayon in 1910, more than 19 artificial fibers have been developed. Today synthetic fibers account for about 70 percent of the fibers used in textile mills. Between 1962 and 1973, per capita

consumption of artificial fibers increased 23 percent while the use of cotton decreased 23 percent and wool consumption fell 72 percent. About 43 percent of all synthetic fibers are used by the clothing and apparel market, 32 percent for home furnishings, and 25 percent for industrial and other uses.

Today, many of the displacement markets have been saturated. As a result, the growth for many petrochemical products will slow to the growth of that overall market (e.g. clothing) in the economy. Still, some new petrochemical products will grow very fast as they displace other nonpetrochemical products.

Petrochemicals are expected to make major inroads in the housing sector where greater use will be made of plastic siding and pipe, thermal insulation, and flame retardant chemicals. As solar heating becomes more widespread, a new demand for heat-absorptive coatings and heat transfer fluids will grow. In the industrial sector, a newly developed engineering plastic that is resistant to heat, wear, and corrosion is finding a market as a substitution for brass, aluminum, copper, bronze, and steel. By 1985 use of plastics in automobiles is expected to grow from 160 pounds to 350-500 pounds per vehicle. These and other new markets could require significant changes in the types and relative proportions of feedstocks from previous trends.

It is questionable, however, whether the previous overall explosive growth in petrochemical sales from 1960-73 could be achieved again. Slowing growth in some markets could cause a significant reduction in petrochemical capacity expansions. For example, enthusiastic plans for new ethylene capacity were being shelved by mid-1978. In other cases, the U.S. petrochemical industry could face significant overcapacity in some areas, until new markets can be developed. Of course, if oil feedstocks become chronically short, market growths and surpluses will become academic concerns.

CONCLUSIONS

The petrochemical industry has undergone significant transformations in its character, feedstocks, and markets. These changes are expected to continue in the future. The extent of these changes are of such magnitude that mere extrapolation of past trends, either in markets or feedstock use, could miss the mark by a very significant margin. The recent large additions of ethylene capacity which were then idled for periods of time illustrate the complexities and uncertainties involved. An adequate Government information

system on petrochemical feedstock requirements would also have to incorporate comparable information on petrochemical markets and products.

Through at least the 1990s, the United States may face chronic scarcities of all liquid and gaseous fuels. Because the cost of feedstock is usually a small part of the final product, the petrochemical industry would appear to have a greater ability to bid for feedstocks than some other industries or consumers under normal market conditions. But given the Government's commitment to respond to diverse interpretations of economic and social fairness, the prospect for a pure market solution appears unlikely. Current Government stand-by allocation rules do not distinguish between feedstock and fuel use in the petrochemical industry. As a result, any shortfalls would disproportionately affect petrochemical output. To avoid such effects, an allocation system would have to recognize the petrochemical industry's needs both for fuel and raw materials. Such an allocation system would include two components

--an adequate representation of the feedstock material inventories and flows in the defined industry and

--an understanding of the economic consequences of diverse allocation formulas.

The required level of detail in understanding the petrochemical industry's role in the U.S. economy will be directly related to the extent to which adjustments in initial allocations by participants in the economy are precluded. For example, a rigid allocation system, such as that existing for gasoline, would tend to lock the economy into relatively fixed patterns of resource use and economic activity. Given the rapidly changing nature of the petrochemical industry and its customers, inflexible patterns could have significantly negative affects. As a result, any attempt on the part of the Government to provide a capability for adjusting a rigid allocation system would require detailed and timely information on the changing dynamics of supply and demand for petrochemicals and their inputs.

Furthermore, any Government program for feedstock allocations will be difficult to formulate and implement, particularly because the feedstock materials (crude oil fractions, natural gas liquids, and natural gas) requirements have significantly different shares of overall U.S. consumption. Crude and natural gas account for approximately 6 percent of overall U.S. consumption of these resources, while feedstock use of natural gas liquids accounts for over 20 percent of total U.S. consumption.

Any Government allocation program that would favor feedstock uses of crude oil and natural gas in the face of constricted supplies would probably have limited impact outside the industry, even if the allocation were made at 100 percent of "demand." On the other hand, an allocation of 100 percent of natural gas liquids feedstock needs would significantly affect the remaining U.S. natural gas liquids users. As a result, any allocation of natural gas liquids for feedstock use will probably be much more difficult to develop and implement than any system for crude oil or natural gas. Thus, it would appear that any major allocation schemes should focus first on the use of natural gas liquids.

CHAPTER 3

PETROCHEMICAL INFORMATION:

STATE-OF-THE-ART

Whatever the desirability of treating the petrochemical industry on a dual fuel/material feedstock basis, the Government presently does not have sufficient information which would allow it to undertake this course of action. As a result, even if Government policies were to recognize this dual basis, it is doubtful whether there could be any effective change in Government actions towards the petrochemical industry, except on an ad hoc basis.

This is not to say that the Federal Government has no data relating to the petrochemical industry. It does. At least seven agencies collect information, which in various ways, is related to the petrochemical industry. A listing of some of the Government's reports resulting from these information gathering activities in the petrochemical area is shown in table 2.

Table 2

Federal Petrochemical Data Activities

Department or agency	Examples of significant publications containing petrochemical data
Energy (DOE)	Energy Data Report, Monthly Petroleum Statements: Crude Petroleum, Petroleum Product, and Natural Gas Liquid
Commerce (DOC)	Annual Survey of Manufactures Census of Manufactures Current Industrial Reports Monthly Import and Export Data
Labor (DOL)	Producer Prices and Price Indices
International Trade Commission (ITC)	Synthetic Organic Chemicals
Interior (DOI)	Minerals Industry Survey Minerals Yearbook
Federal Reserve Board (FRB)	Federal Reserve Bulletins Industrial Production
Agriculture (USDA)	Agriculture Statistics Consumption of Commercial Fertilizers Fertilizer Situation

Each of the agencies listed above has developed its data base as a result of their interest and expertise in the respective areas. But the data have not been gathered into a unified information system which could provide a basis to assess the fuel and feedstock requirements of the petrochemical industry. The information gathered often deals with particular aspects of the industry, such as the International Trade Commission's information on synthetic organic chemicals, or the industry is treated as a small part of an overall picture, as in the case of the Mineral Yearbook put out by the Interior, with a resultant loss of detail.

Even information systems that seek to deal with the petrochemical industry as a separate entity, and in some detail as well, have serious deficiencies. An analysis of the Government petrochemical industry information has indicated the following general deficiencies:

--Lack of a uniform definition of the industry.

--Lack of inventory data.

--Lack of adequate petrochemical feedstock data.

--Lack of timely data.

LACK OF A UNIFORM DEFINITION OF THE PETROCHEMICAL INDUSTRY

Where we discussed the petrochemical industry previously, we couched most of our discussion in qualitative terms. To understand adequately the fuel/material feedstock interrelaships in the petrochemical industry will require more than qualitative information. And, obviously, this information cannot be obtained without an agreement on a relatively precise definition of the petrochemical industry. Unfortunately, there is no uniform definition at this time.

A definition of the petrochemical industry can be constructed either from its operations or from an assessment of its markets. Either method has serious difficulties, which in the end must be resolved by arbitrary decisions.

From an operational standpoint, it is difficult to draw the line between refinery operations and petrochemical operations. As a result, arbitrary decisions must often be made on what is excluded and included in the make-up of the industry 1/. It is further complicated by the fact that the

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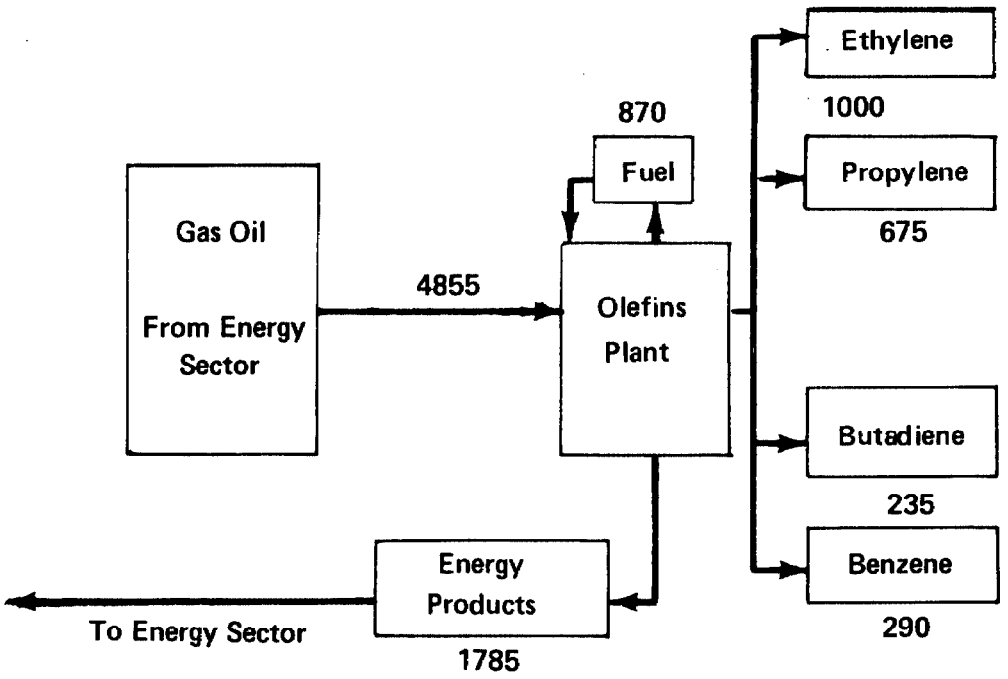
1/Report to the Congress on Petrochemicals, Federal Energy Administration, Sept. 1974, p. 11.

petrochemical "feedstock" in a refinery/petrochemical complex provides both energy and feedstock to the petrochemical part of the complex which in turn feeds some energy back to the refinery. An example of a refinery-olefins complex is shown in figure 1. The difficulty in separating refinery/petrochemical operations will grow in the future because of the increasing number of such refinery/petrochemical complexes.

Figure 1

FIGURE 1 TYPICAL REFINERY – PETROCHEMICAL COMPLEX (MM lb./yr)



The petrochemical industry can also be assessed from a market perspective, using the Department of Commerce's Standard Industrial Classification (SIC) code. Unfortunately, it is not possible to clearly separate petrochemical by SIC code, because the petrochemical industry does not exist as an industry classification. Therefore, the Department's Material Division, Chemical and Rubber Program, has attempted to categorize the industry into portions of 16 SIC groupings. For each of these SIC codes, Commerce has developed conversion factors to determine what percent of the business in that classification is the petrochemical component. Unfortunately, development of new products could take the petrochemical industry into new SIC codes or increase its share of its current SIC codes.

Table 3 illustrates Commerce's definition of the petrochemical industry by SIC codes as of 1977. The conversion factor is the percentage of business the petrochemical industry accounts for in that SIC code. Table 3 shows that only five SIC codes are totally based on petrochemicals. In 1977 they accounted for $21 billion, or a little more than one-third of the value of petrochemical industry shipments estimated by Commerce.

Table 3

Petrochemical Component of Petrochemical Industry Groups

SIC	Industry group	Conversion Factor - Percent
2821	Plastic Materials & Resins	100
2822	Synthetic Rubber	100
2824	Organic Fibers	100
2833	Medicinals & Botanicals	80
2841	Soaps & Detergents	50
2843	Surface Active Agents	90
2844	Toilet Preparations	50
2851	Paints & Allied Products	50
2865	Cyclic Crudes & Intermediates	90
2869	Industrial Organic Chemicals	90
2873	Nitrogenous Fertilizers	100
2879	Agricultural Chemicals NEC	80
2891	Adhesives & Sealants	75
2892	Explosives	75
2893	Printing Inks	50
2895	Carbon Black	100

However, just as somewhat arbitrary distinctions are made between refinery and petrochemical activities when describing the petrochemical industry from an operational perspective, equally arbitrary distinctions are made when describing the industry from a market perspective. Table 4 compares the 1977 Commerce definition to those of three more recent studies.

Table 4

Comparison of Petrochemical Industry Definitions

Product code	Industry group	DOC 1977	DOC 1979 draft	FEA	PEG
SIC 2821	Plastic Materials & Resins	X	X	X	X
SIC 2822	Synthetic Rubber	X	X	X	X
SIC 2824	Organic Fibers	X	X	X	X
SIC 2833	Medicinals & Botanicals	X			X
SIC 2843	Surface Active Agents	X	X		X
SIC 2865	Cyclic Crudes & Intermediates	X	X	X	X
SIC 2869	Industrial Organic Chemicals	X	X	X	X
SIC 2873	Nitrogenous Fertilizers	X	X	X	X
SIC 2892	Explosives	X			
SIC 2895	Carbon Black	X	X	X	X
SIC 2841	Soaps & Detergents	X			
SIC 2844	Toilet Preparations	X			
SIC 2879	Agricultural Chemicals	X			
SIC 2891	Adhesives & Sealants	X			
SIC 2893	Printing Inks	X			
SIC 2851	Paints & Allied Products	X			

These three studies (FEA, draft DOC and PEG 1/) have a good consensus on the definition of the petrochemical industry. Their estimates of the total value of industry shipments vary by only about 5 percent. They differ over whether medicinals (SIC 2833) and surface active agents (SIC 2843) should be included.

The 1977 Commerce definition, however, differs significantly from the other three. It includes SIC codes in the petrochemical industry which other studies consider to be petrochemically-based at best, not part of the petrochemical industry. The value of shipments estimated from the 1977 Commerce definition exceeded the estimates resulting from the other three definitions by about 25 percent in 1978.

1/Petrochemical Energy Group (PEG), is an industrial association of independent petrochemical (nonintegrated petroleum companies) companies.

Furthermore, these market-based definitions exclude refineries (SIC 2911) that also produce petrochemicals. Thus, these definitions can significantly understate the amount of energy consumption. This can be seen in table 5 which indicates the range of estimated petrochemical industry energy use for 1976 from three different sources.

Table 5

Estimates of the Petrochemical Industry's Consumption of the Total U.S. Energy Consumption in 1976

	Percent of total consumption	Trillion Btu's (note a)
A.D. Little, Inc. for PEG	5.6	4,173
Shell Oil Co. - TREND magazine	8	5,961
Oil and Gas Journal	9	6,706

a/GAO estimation from overall 1976 energy use of 74,513 trillion Btu's of total U.S. energy consumption.

Table 5 indicates that the current uncertainty in energy use by the petrochemical industry ranges over 2,533 trillion Btu's, or 3.4 percent of total U.S. energy consumption in 1976. Such a wide range indicates that the Government would have a difficult time, through existing information systems and decision frameworks, in allocating hydrocarbon energy supplies, whether for fuel or feedstock purposes to the industry, consistent with its importance to the economy and the Nation.

LACK OF INVENTORY DATA

Inventory changes are critical for providing a measurement of an industry's activity. However, inventory data on the petrochemical industry are not collected, even though some analysts believe that annual data on selected petrochemicals could provide the basis for feedstock allocation decisions. Several proposals for developing such a data base have been made in the past, but, for various reasons the proposals were never implemented (e.g., budget restrictions).

It is well to bear in mind, however, that collection of inventory data could possibly dissuade the build-up of private inventories should such inventories be seen subject to an eventual allocation regime. As a result, collecting inventory data could tend to exacerbate any shortages if potential

economic benefits of such stockpiles were perceived as unrealizable by the firms most likely to invest in stockpiles either for their own use or for sale to others.

Inventory information can provide the Government better information on actual petrochemical feedstock use and thus assess the seriousness of any perceived shortage. For example, the petrochemical industry and DOE have disagreed strongly over Energy's policy regarding the use of propane. The industry claims through the Petrochemical Energy Group that DOE has underestimated actual petrochemical industry use of propane as a feedstock material. Current DOE information is based almost totally on "sales" of feedstock material by the petrochemical and natural gas industry, not on its use by the petrochemical industry. Knowledge of sales to a particular industry without knowledge of inventory changes can result in over or understatements of actual use. The PEG analysis claims that the DOE's understatement of propane use as a petrochemical feedstock results from DOE's not taking into account the drawdown in propane inventory by the petrochemical industry. At this point, because DOE does not possess such inventory data, the dispute between it and the industry cannot really be resolved.

Inventory information for the petrochemical industry should be viewed from both the aspect of feedstock and product. For example, a petrochemical facility can produce varying proportions of propylene and ethylene depending upon the relative volumes of propane and ethane feedstocks. Sometimes because of market conditions, large inventories of propylene or ethylene could be built up. If a shortage of propane were to occur while there were large inventories of propylene, then it would be possible to shift some propane away from feedstock use. Similarly, if there were limited propylene inventories, then the Government might have to consider higher allocations of propane as a feedstock.

LACK OF ADEQUATE PETROCHEMICAL FEEDSTOCK INFORMATION

The Federal Government is virtually the sole source of U.S. petrochemical feedstock data on a national basis. Three main sources of Government data on petrochemical feedstocks are the

--DOE/Energy Information Administration, Petroleum Statement Monthly: Crude Petroleum, Petroleum Products and Natural Gas Liquids,

--DOE, Petrochemical Plant Schedule, and

--DOC, Census of Manufactures.

The monthly Petroleum Statement contains information on refinery sales or transfers of petrochemicals and petrochemical feedstocks, but it contains no information about feedstock uses by petrochemical facilities. Furthermore, industry analysts contend that the data are not reliable, or timely enough for private sector needs.

The data are not a reliable measure of petrochemical industry consumption of crude oil fractions and natural gas liquids for feedstock purposes for two reasons. First, they reflect sales, not consumption. Sales data cannot be related to consumption without knowledge of inventory changes at the related petrochemical facilities. Second, the actual amount of petrochemical feedstock sales is overstated. This is because some "sales" are actually petrochemical products such as cumene or fuels for petrochemical operations, not petrochemical feedstocks.

Data for the Petrochemical Plant Schedule are collected by the DOE, Office of Oil Imports. These schedules report consumption of petrochemical feedstock; however, these data are only reported for petrochemical facilities involved in the oil import quota program. Thus, most of the U.S. petrochemical industry is not included in these data. For example, the 1977 Petrochemical Plant Schedules includes only 2 of the 13 plants of Exxon Chemical Company U.S.A. Similarly, the schedule reported inputs and outputs of petrochemicals for only five of Gulf Oil Chemicals Company's eight U.S. plants.

The Census of Manufactures can provide a basis for a relatively comprehensive assessment of the petrochemical industry. It is arranged by SIC codes and gives relatively detailed information on both feedstock and fuel use. Recent proposed Commerce changes, which have been accepted by the Office of Management and Budget, are expected to be even more detailed.

However, the price paid for such detail is a lack of timeliness; the 1977 Census of Manufactures is currently being published. Furthermore, the user would still need a standard definition to combine the various SIC codes to determine the feedstock use of the petrochemical industry.

Private sources of information on the petrochemical industry can provide a basis to estimate feedstock use, but this information tends to be product or feedstock specific. For the most part, however, the private sector does not collect data on petrochemical feedstock purchases or

consumption. Most private information systems are estimates based on Government statistics and adjusted in some way to compensate for their shortcomings.

LACK OF TIMELY INFORMATION

Most data on the petrochemical industry is now significantly dated and is highly aggregated both regarding time and detail of feedstock/fuel use. The Petroleum Statement, while published monthly, is usually issued from 5 to 7 months after the end of the month being reported. Census of Manufactures' data are at least 2 years old when published. Reports by independent consulting firms that provide estimates of recent activities, usually have no more current data than are available from Government sources.

Energy events change rapidly. The 1973-74 oil embargo occurred almost without warning. Other significant happenings such as the natural gas shortage of 1976, the natural gas bubble of 1978, and the 1979 Iranian shutdown were before policymakers with similar suddenness. In such situations, where policies must be decided and reactive programs must be implemented quickly, information which is several years old and which has been aggregated into annual figures may obscure or hide newly developing trends.

However, timely data does not provide information to an allocation system unless it is accompanied by an ongoing analysis of that data. For example, DOE did not adjust its allocation system to take into account the effects of recent changes in regional population or even the effects of the severe winter of 1978 on gasoline consumption trends. As a result, many believe that the gasoline lines of 1979 were as much a result of an outdated allocation system as they were of any physical shortages.

We suspect that any allocation system designed to deal with the petrochemical industry would pose an even more difficult situation than an allocation system for gasoline. The production and distribution chain for petrochemical feedstocks and products is much more complex than for gasoline. New products are developed almost yearly. Markets change character as petrochemical products reach their maximum displacement of nonpetrochemical competition and sales fall to the growth rate of the market itself, not market plus displacement. New markets develop as petrochemical products are used to displace other materials (e.g., plastics for steel in automobiles).

CONCLUSIONS

While the state of knowledge of the petrochemical industry could provide some understanding of the aggregate long-term trends in petrochemical fuel and feedstock use for purposes of general policy considerations, this information could prove inadequate should events significantly affect the long-term trends. In the face of any short-term supply difficulties, it is likely that current petrochemical industry trends could be altered significantly. As a result, the state of knowledge of the petrochemical industry is inadequate to provide a basis on which the Nation could make decisions affecting the trade-offs involving the allocation of petroleum and natural gas between its energy and material feedstock uses.

The overall problem of substituting governmental allocations for the usual market mechanism is extremely complex. But, however the problem is viewed and simplified, a consistent and comprehensive definition of the industry together with a system describing stocks and flows of primary inputs are logical precursors to any more elaborate efforts that might be deemed necessary.

The changing nature of the petrochemical industry significantly complicates any attempts to develop timely and adequate information on petrochemical fuel and feedstock use. While there is something of a consensus regarding the definition of the petrochemical industry from a market standpoint, there is limited consistency in fuel and feedstock information or how fuel and feedstock uses in the petrochemical industry relate to economic activity. Most timely estimates of fuel and feedstock requirements are a combination of judgment on the part of analysts plus spotty information. As a result, particularly from a fuel and feedstock use, it appears that there are almost as many petrochemical industries as there are analysts. Thus, a definition of the industry from an energy basis and how that relates to economic activity is critical.

CHAPTER 4

OVERALL CONCLUSIONS AND RECOMMENDATIONS

Current U.S. policy is aimed at not allowing U.S. oil imports to exceed 8.5 million barrels per day. If this policy is maintained, it is likely that overall U.S. supplies of petroleum (domestic plus imports) will decline about 10 percent below current levels by 1990. While there are presently no proposed natural gas import restrictions, U.S. supplies of natural gas will probably also be under very severe constraints because (1) domestic supply will continue to decline and (2) increased pressure will be placed on natural gas to compensate for the severely constricted availability of petroleum.

Given the import constraints, the Government will probably assume a large, and perhaps growing, role in allocating the increasingly restricted supplies of petroleum and natural gas available to domestic consumers. Under present standby allocation rules, the petrochemical industry does not have its unique material feedstock uses of petroleum and natural gas fully recognized.

Current discussions between industry and Government regulators indicate that there is a great fear on the part of the petrochemical industry that their feedstock needs will be treated on the same footing as overall energy uses. Our analysis has indicated that:

1. Such treatment could result in feedstock shortfalls that could affect petrochemical output more directly than mere energy shortfalls.

2. While feedstock uses of crude oil fractions and natural gas are quite small relative to overall use, the feedstock uses of natural gas liquids represent a major share of overall natural gas liquids.

3. The character of feedstock use is beginning to change as the petrochemical industry switches to crude derived feedstocks.

4. The current state of knowledge cannot provide a basis to assess the trade-offs between petrochemical material and feedstock uses of petroleum and natural gas as opposed to uses elsewhere in the economy and within the petrochemical industry itself.

As a result, priority must be given to the development of a standardized definition of the petrochemical industry from the vantage point of allocations. It must be recognized, however, that a "moving target" is involved. Even after a base definition is established, future changes in the definition will likely be necessary.

Failure to have an adequate information system in place and debugged prior to any significant constriction of supplies would mean that any Government allocations affecting the petrochemical industry would be at best marginally effective and possibly more harmful than beneficial. We believe that such an information system must include not only adequate data but adequate analysis to render that data useful.

The volatile, changing nature of feedstock use in the petrochemical industry indicates that any Government information must include analysis of consumption and production trends in an explicit and easy-to-use fashion. The Nation's recent experience with the allocation of gasoline indicates that an effective allocation system must be responsive to two basic factors:

--Current or recent levels of consumption.

--Trends in these levels.

While we recognize that the current Government information systems are inadequate, they are the only information we have today, and they can provide a beginning. The construction of an adequate information system for the petrochemical industry should not result in any immediate termination of the other data collection efforts, even if those efforts appear duplicative of the new system. Any premature termination could significantly undermine the ability of data analysts to have sufficient information on long-term trends in the petrochemical industry. Without a reasonable amount of overlap, there would be almost no knowledge of the trends in the petrochemical industry.

Ideally, information on the petrochemical industry's use of hydrocarbons for both energy and material purposes should be available (1) by type of fuel by industry sector, (2) by geographic region, and (3) reported on a timely basis at a level of detail that provides a representation compatible with other data series available to government and industrial decisionmakers. This compatability will provide a basis to assess the consistency of the various data series. At present, no government or industry data bases meet these criteria. While such a system might be achievable in the long term, it is doubtful whether any data system could be developed to meet these criteria simultaneously, in the short-or mid-term.

Accuracy is of prime importance. But, accuracy also requires time. The faster the data must be assembled, and the greater its detail, the greater the likelihood for inaccurate or incomplete data. Thus timeliness, detail, and accuracy are critical factors that cannot be achieved simultaneously to any ideal extent. One must dominate, particularly when a data set is being developed. In the long-term after the information system has been developed, the need for tradeoffs can be reduced because the information developed previously can provide a basis to develop corrections for inaccuracies or estimates in lieu of slow data. During initial development of the required data-allocation system, it would be most desirable to give priority to developing timely and accurate data before developing any extensive detail in the data.

The level of detail of the physical data needed, together with a required superstructure of economic impact, will depend on the flexibility inherent in the particular allocation system considered for implementation. The less flexible the allocation system, the more detailed the data system would have to be. We consider that economic efficiency would be more likely to occur under a system permitting adjustment within broad governmental allocation rules rather than under a complex system of detailed allocations attempting to respond to rapidly changing market needs.

RECOMMENDATIONS

We recommend that:

--The Secretary of Energy working in collaboration with the Secretary of Commerce establish a standardized definition of the petrochemical industry for allocation purposes. The definition, and the rationale supporting it, should be provided to the Congress no later than 6 months from release of this report.

--The DOE define information requirements necessary to support timely allocations of petroleum, natural gas, and natural gas liquids feedstocks, should conditions necessitate direct Government apportionment of supplies. The new allocation system should be responsive to industry needs for both energy and materials requirements. Initial priority should be given to allocation procedures for natural gas liquids.

--As part of his report to the Congress, the Secretary of Energy explain the rationale for anticipated stand-by allocation procedures, including examination of alternatives for maintaining as much market flexibility as possible.

--within 1 year following issuance of this report, DOE submit to the Office of Management and Budget and the Congress, its recommendations for medium to long-term phasing out of any existing data systems that overlap or are duplicated by the new system to be developed around a viable definition of the petrochemical industry. In doing so, sufficient time must be allowed, however, to ensure that collection of data revealing significant trends in petrochemical industry consumption and production is not prematurely halted.

AGENCY COMMENTS

We requested and received comments from DOE, ITC, and DOC. They generally agreed on the needs we addressed: a standardized definition of the petrochemical industry, an adequate information system to support a feedstock allocation program, and an allocation system that recognizes the feedstock needs of the petrochemical industry.

DOE fully agreed with the general issues we presented and concurred with our recommendations to establish a standardized definition of the petrochemical industry and to improve DOE's petrochemical information system. All of Energy's comments are included as appendix I. DOE cited efforts started or ready to start with DOC to arrive at a standard definition and improve petrochemical information.

DOC also agreed with our recommendations and noted the importance of the petrochemical industry, both to our domestic economy and to our export balance of payments. It noted that periodic re-examination and change is needed to reflect the technological and economic changes that will occur over time. Finally, DOC noted that the Bureau of the Census has been authorized to expand its annual survey of manufactures to include petrochemical information. The full text of its comments are included as appendix II.

The United States ITC likewise agreed with our major report premises. It said that

"current Government allocation-of-shortage regulations based on fuel use, could result in serious feedstock shortages for petrochemicals, and that alleviation of any such shortages must be based on a timely and adequate data base."

ITC suggested refinements to improve the report, make it technically more correct, and present the feedstock problem in clearer terms. Their detailed comments are included as appendix III.

APPENDIX I

Department of Energy
Washington, D.C. 20585

Mr. J. Dexter Peach, Director
Energy and Minerals Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

We appreciate the opportunity to review and comment on the GAO draft report entitled "DOE Emergency Allocation Rules Fail to Recognize Feedstock Needs of Petrochemical industry." Our views with respect to the text of the report and recommendations contained in the report are discussed below.

In essence, DOE fully agrees with the general issues raised in the report. The report is timely in light of the possible serious constriction of petroleum supplies, the unique dependence of the petrochemical industry on petroleum supplies for feedstock as well as energy needs, and the significant impact that a disruption of petroleum feedstock supplies to the industry could have on the U.S. economy. Department of Commerce projections for 1980 indicate the value of U.S. petrochemical industry shipments will be more than $75 billion, with foreign export of these shipments amounting to about $10 billion.

DOE concurs with GAO's recommendation that a standardized definition of the petrochemical industry is needed. Lacking such a definition, meaningful allocations of petroleum feedstocks and energy needs cannot be made. The Energy Information Administration (EIA) within DOE, is ready to begin working with the Department of Commerce (DOC) and the Economic Regulatory Administration (ERA) in developing a standardized definition of the petrochemical industry for allocation purposes. The EIA will provide the ERA with any requested assistance in defining information requirements necessary to support timely allocations of petrochemical feedstocks.

DOE also agrees that the present petrochemical data system needs to be revamped. Present systems do not report data on a timely basis, lack uniformity, and lack petrochemical feedstocks and product inventory data. The EIA supports the concept of improving data collection efforts needed for an emergency allocation program for petrochemical feedstock. An agreement between the EIA and the DOC has been reached whereby the EIA will fund a DOC project to collect data from the petrochemical industry. The next Annual Survey of Manufacturers will include a supplement which will collect annual data for 1978 and 1979 on the quantities of 20 different petrochemical feedstocks consumed during these years. This effort should provide good benchmark data. The survey itself already collects data on the quantities of fuel and energy consumed by the petrochemical industry.

We appreciate your consideration of these comments in the preparation of the final report and we will provide further comments or clarifications that you may require.

Additionally, editorial comments pertaining to this report were separately provided to your staff.

Sincerely,

Jack E. Hobbs
Controller

APPENDIX II

UNITED STATES DEPARTMENT OF COMMERCE
Chief Economist for the Department of Commerce
Washington, D.C. 20230

[illegible] 1980

Mr. Henry Eschwege
Director
General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

The Commerce Department agrees with many of the findings contained in the draft of your proposed report, "DOE Emergency Allocation Rules Fail to Recognize Feedstock Needs of Petrochemical Industry".

This report, which has been reviewed by the chemical industry specialists of our Bureau of Industrial Economics, is an effective and much needed analysis of the prospective problems related to feedstock supplied for this important sector of our economy. Petrochemicals are expected to account for more than $75 billion in value of shipments during 1980, including $10 billion in export shipments.

We concur with your recommendation that "The Secretary of Energy working in collaboration with the Secretary of Commerce establish a standardized definition of the petrochemical industry" and that this definition should be provided to Congress by June 30, 1980. In fact, our chemical industry specialists have been working in collaboration with the other Federal agencies and industry groups concerned with this problem for some time. In our discussions, we have emphasized that the definition of the petrochemical industry must clearly differentiate hydrocarbon products made from natural gas and crude oil which are used as feedstocks (i.e., as raw materials), from hydrocarbons which are used as fuels (i.e., as sources of energy). The definition should be re-examined periodically to insure that it reflects the technological and economic changes which will continue to affect this industry.

We agree that the present information system used by DOE for allocation of feedstocks must be improved. As one step in this direction, the Bureau of the Census has just received

approval from OMB for an expansion of the Annual Survey of Manufacturers to collect data on feedstock requirements of the U.S. chemical industry. We also agree with your recommendation that existing data systems be examined and overlap and duplication eliminated, but that all relevant existing information systems be retained during the development of a new system.

Thank you for the opportunity to comment on this draft report.

Sincerely,

Courtenay M. Slater

Courtenay M. Slater
Chief Economist for the
Department of Commerce

APPENDIX III

CHAIRMAN

UNITED STATES INTERNATIONAL TRADE COMMISSION

WASHINGTON D.C. 20436

FEB 1 1980

Mr. J. K. Fasick
Director, International Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Fasick:

Thank you for inviting the United States International Trade Commission's review of your draft report, "DOE Emergency Allocation Rules Fail To Recognize Feedstock Needs of Petrochemical Industry." We agree with the report's major premise that current Government allocation-of-shortage regulations, based on fuel use, when combined with the President's program of holding future U.S. oil imports below 8.5 million barrels per day, could result in serious feedstock shortages for petrochemicals, and that alleviation of any such shortages must be based on a timely and adequate data base.

Overall, the draft report is a good initial effort. Further refinement will improve the report, make it technically more correct, and present the feedstock problem in clearer terms. For example, as currently written, it appears that the entire petrochemical industry must be defined and statistically related to its demand for petrochemical feedstocks and the negative impact that allocation of energy material based strictly on their use as fuels (as opposed to feedstock uses) would have on the petrochemical industry. This is not the case. Data for a limited list of the most important individual petrochemicals would account for 90 percent of the demand for feedstocks, and the remainder could be factored in. The overall petrochemical industry approach used in the report dilutes the all-important feedstock picture.

APPENDIX III

Following the above concept, conclusions and recommendations concerning petrochemical feedstocks themselves would remain essentially intact. However, the conclusions and recommendations as regards a drastic revamping of all current petrochemical data collection efforts would not be necessary and attention instead should be directed to developing a data collection system aimed at capturing the specific petrochemical feedstock data that would be needed for a good petrochemical feedstock allocation program.

A further discussion of the above comments is appended for the benefit of your staff. In addition, we suggest that a meeting of staff members be held at which all the technically difficult questions can be resolved with a minimum of time and effort. The examples cited in this letter are mainly to indicate the direction of our thinking. Since the final report is to be used by others, it should be as technically correct as possible.

Please continue to call on us whenever we can be of assistance.

Sincerely,

Catherine Bedell
Chairman

Enclosure

Summary of ITC Comments on GAO's Draft Report

Page	GAO position	USITC comment
i, 15, 16, 39, 40	Petrochemical industry is extremely important but is threatened by cutoff of raw materials (i.e., feedstocks) because, due to the energy shortage, these raw materials may be preempted by fuel demand. These raw materials come from petroleum and natural gas. Government regulators are ignorant of the problem and have no organized data base to deal with it in any case.	Agree that present Government policy and failure to recognize the raw material needs of the important and growing chemical industry can jeopardize its continued viability. Disagree that there are insufficient Government data available. The new Census forms, MA-451 and MA-452 designed to collect data for DOE, will close the last data gap--that of feedstocks use. Timeliness can come later.
iv, 20, 21, 39	If extreme shortage comes, current allocation system would discriminate against petrochemicals because it is based on "equally sharing shortages" and only on demands for fuel.	Agree with GAO as far as they go. But GAO omits the additional factor that some major petrochemical raw materials may be required to build the octane rating of gasoline and would be preempted by oil companies absent a policy that recognizes their essentiality in petrochemicals.
vi, 25, 26, 26A, 27, 28, 32, 33, 34, 40, 41	There is no Government information system on (a) petrochemicals or (b) fuel/feedstock split. There is a strong need for a revamped information system.	Disagree. The U.S. International Trade Commission statistics on synthetic organic chemicals cover 90+ percent of the products of the petrochemical industry, and Census and the Bureau of Mines supply the rest. Census' new reporting system covers the feedstock problem. Commerce (Office of Basic Industries) has developed a definition of the industry which has been widely circulated to Government and industry for "approval."

(See GAO note, p. 41.)

Summary of ITC Comments on GAO's Draft Report--Continued

Page	GAO position	USITC comment
		Census has begun collecting detailed data on consumption of feedstocks and fuel by chemical plants and oil refineries, by Forms MA-451 and MA-452. All that is needed is organization and slight modification of the existing systems.
1	Establishes basic definitions.	Question. Distinctions between the petrochemical, organic, inorganic and chemical industries should be explained. The data presented should be related specifically to the industry they relate to. For example what is "bulk petrochemical production"? It is unclear as to what the "chemical industry" refers to. Does it include the inorganic chemical industry or is it just the organic chemical industry or the petro-chemical industry?
3, 4	Discusses coming decline of U.S. supplies of natural gas liquids.	Question. In addition to discussing the U.S. supply situation, mention should be made of the plans for larger natural gas extraction plants in the Middle East and other natural gas producing areas. According to some industry observers, there is the distinct possibility that more natural gas liquids (NGL) will be available in the future than has generally been thought to be the case. Future growth in the petrochemical industry may not be "almost totally based on oil-based feedstocks" (p. 4).

Summary of ITC Comments on GAO's Draft Report--Continued

Page	GAO position	USITC comment
11, 12 13	Reforming produces a mixture of basic aromatics (benzene, toluene, xylenes) which "has considerable value as a high octane gasoline blending component."	Incomplete. It should be noted that the quantities of benzene used in gasoline are limited because of the toxicity of benzene. It should also be pointed out that aromatics are separated into benzene, toluene and mixed xylene fractions. The mixed xylenes may then be separated further into the xylene isomers which in turn are used to make petrochemicals. It would also help the reader of the draft report if the sources for certain data contained therein were cited, unless the data were actually developed during the work leading up to the report. For example, the source(s) should be given for the percentages of ethylene, propylene and benzene capacities attributed to "integrated petroleum refiner-petrochemical companies" (p. 12), the number of firms associated with 80 percent of the total output of intermediates (p. 13) and the percent of energy resource consumption attributed to the petrochemical industry (also p. 13).
14	Discusses split between fuel and feedstock use of petrochemical feedstocks.	Incomplete. The second paragraph is indicative of sections of the report that could benefit from reworking to increase technical accuracy. As written it is difficult to follow and the relationship between the

APPENDIX III

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Page	GAO position	USITC comment
		many terms used never becomes clear. The state of knowledge of petrochemical data (the chemicals, not the feedstocks) has little to do with the difficulties encountered in defining and collecting petrochemical feedstock data vis-a-vis petrochemical energy data.
9 to 22	Chapter 2 attempts to relate the entire petrochemical industry to the problem of securing adequate raw materials.	Disagree. Instead of a chapter on the entire petrochemical industry (Chapter 2 in the draft report), a chapter limited to petrochemical feedstocks would appear more appropriate. This chapter could go into what petrochemical feedstocks are and their relationships to primary petrochemical technology and production facilities. Discussion would center on each of the two large primary petrochemical groups (olefins and aromatics), including the companies that produce these materials, and the types of facilities and feedstocks used.
23 to 38	Chapter 3 claims that Government data on petrochemicals are limited and not suitable for allocation purposes.	Disagree. This chapter, following the above paragraph, should be concerned not with the state of the art of all petrochemical information in the Government, but with petrochemical

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Page	GAO position	USITC comment
		feedstock information in particular. The currently available Government petrochemical data are adequate and are used as a standard by the industry. The data contained in the annual U.S. International Trade Commission (USITC) report, Synthetic Organic Chemicals, U.S. Production and Sales, are accurate and complete, are widely used and quoted in Government and industry reports and consultant organizations' publications, and are available from no other source. These data together with the other petrochemical data collected by other Government entities (as listed in Tables of the draft report) fully describe the U.S. petrochemical industry. In summary, the data on petrochemicals themselves are complete and capable of being organized to serve as the base for an allocation program. What do need to be improved are petrochemical feedstock data. This would necessitate canvassing the users of petrochemical feedstocks as opposed to their producers. Since many petrochemical feedstocks are identical to those items used to generate energy, it is actual use that separates petrochemical feedstocks from fuels, and the only contact point that knows how a particular item is to be used is the industrial

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Page	GAO position	USITC comment
		consumer (as opposed to the producer). In addition, some petrochemical feedstocks are imported in which case obtaining data from the importer on actual use might not reveal the facts.
ix, 20, 43	Recommends that DOE and Commerce (a) collaborate to establish standard definitions of petrochemicals suitable for allocation purposes and (b) define information requirements necessary to support an allocation program.	No problem. The definition has been drafted in Commerce. More important, monthly and/or annual data are already available on all petrochemicals and their feedstocks. All that is needed is organization of what already exists.
44	Recommends that DOE define its information requirements for allocation requirements. A new data system would emerge. Existing data systems should be phased out.	Question. This has begun, as witness the MA-451-452 Census forms. The ITC system is already complete (except for inventory data). We do anticipate some modification of the existing systems, but we fail to see how this would result in any phasing out of an existing system. DOE has shown no inclination or desire to collect petrochemical data itself (again as witness the MA-451-452 program).
2, 3, 10, 14	"Feedstock for the U.S. petrochemical industry has historically been based on natural gas liquids."	Disagree. The GAO statement applies only to ethylene. The other olefins and the aromatics come mainly from oil refinery liquids from cat crackers and reforming units. See the attached colored diagram (from an internal Exxon report) for clarification.

Summary of ITC Comments on GAO's Draft Report--Continued

Page	GAO position	USITC comment
3, 4, 39	Present Government policy on energy allocations and on limiting imports of crude oil will injure the petrochemical industry, which normally should continue to grow faster than the general economy. The problem is worse for chemicals than for other industries.	Agree
12	Identifies "chlorine and caustics" as petrochemicals.	Disagree. They are not petrochemicals. They are made from common salt.
13	Petrochemical companies are building flexibility to switch their fuel needs to coal.	Question. Because of mushrooming costs to transport coal, the Celanese coal-based power plant, at Pampa, Texas, is not earning a return on the investment. It may be some years before additional such units are built.
15	ITC's data on synthetic organic chemicals "deals with a very narrow segment of the industry."	Disagree. GAO seems to be unaware that "synthetic organic chemicals" is synonymous with "petrochemicals," with the exception only of ammonia and sulfur. The ITC data include all of the production and sales data for all of the 17,000 commercial organic petrochemicals as well as most of the data for their feedstocks.
30, 31, 32, 36	Inventory data are lacking (and should be collected).	Question. As GAO itself points out, collection of such data would eventually penalize the prudent operator and therefore would discourage the buildup of inventories and would exacerbate any shortage

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Page	GAO position	USITC comment
		situation. At least some industry sources maintain that inventories of feedstocks, the most critical factor, are relatively small; inventory data, therefore, should not be collected. The "white market" concept (p. 36) would not be a free market and therefore might not be accepted or efficacious.
32, 33 34	Feedstock information are lacking.	Disagree. The GAO draft was probably completed before Census started its DOE-inspired collection of such data (on forms MA-451 and MA-452). This new system can be modified and/or made more timely if circumstances demand it.
34, 35	Present information is not timely.	Question. ITC's monthly reports on the most important petrochemicals are mailed out only 6 weeks after the end of each month; this schedule could be shortened in a time of emergency. We assume that Census could develop similar timeliness for data related to petrochemicals.

GAO note: Page references in this appendix refer to the draft report and do not necessarily agree with the page numbers in this final report.

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