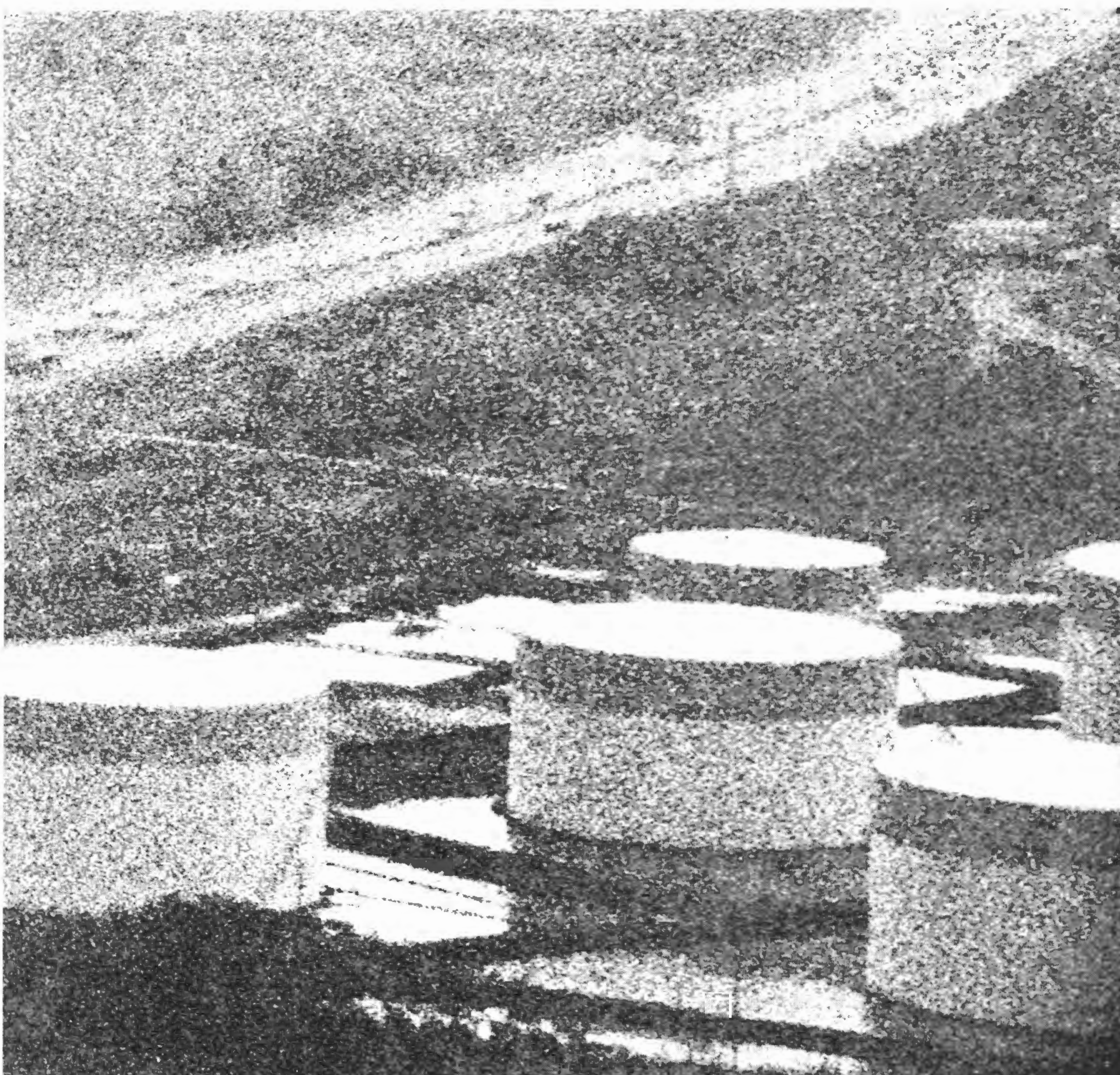
U.S. Department of
Transportation

# Effects of Oil Deregulation on Public Transportation



August 1984



# Effects of Oil Deregulation on Public Transportation

Final Report
August 1984

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16. Abstract

This report reveals the impacts of oil deregulation on transit systems. Basically, it addresses the uncertainty which has been created in terms of diesel fuel price and supply during minor and moderate oil supply disruptions. It identifies six alternative methods of reducing this uncertainty for transit systems and then evaluates these alternatives against three separate lists of criteria involving the breadth, cost and institutional impacts of each.

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EFFECTS OF OIL DEREGULATION
ON PUBLIC TRANSPORTATION

## EXECUTIVE SUMMARY

### Introduction

This work is concerned with the Federal deregulation of petroleum prices and supplies, and its effects on the vulnerability of public transportation systems to future oil supply disruptions. During the 1970s, when the world was rocked by three major disruptions in the flow of oil, transit systems were insulated from many of the difficulties others experienced due to direct Federal intervention. Since 1981, however, the Federal government has discontinued its interventionist role. Furthermore, if an oil supply disruption arises, it has been the oft-stated policy of the Federal administration (Circa 1983-84) not to reimpose former controls nor to pursue new controls. What led to this situation was a widescale reevaluation of Federal controls during earlier contingencies: the controls were judged to be at best, ineffective and at worst, contributors to the overall problem. Without the special treatment afforded them in the past, transit systems must face future oil supply disruptions from the same uncertain perspective as other petroleum product consumers.

Public transit systems cannot simply respond to oil disruptions as any other free-market consumer would: spend more or consume less. Nearly all transit systems are deficit operations; there are few if any contingency funds available to accommodate the types of rapid and steep price increases associated with supply disruptions.

Alternatively, for transit systems to consume less fuel would involve reduced or significantly altered services. Oil disruptions have been shown to be boom periods for transit demand, as a portion of private vehicular users switch over to public transportation. It is crucial for transit systems, therefore, to maintain pre-disruption levels of operations and possibly supplement them with expanded services to meet added demand.

### Objectives of This Work

This work has two related objectives. The first is to analyze the full range of uncertainty that oil deregulation has created for public transit systems in the event of another oil disruption. Second, this work formulates, evaluates, and recommends various options to reduce this uncertainty among public transit systems.

### Oil Markets in the 1970s

In the 1970s two related developments altered the relationships among suppliers, consumers and government. First, the Organization of Petroleum Exporting Countries (OPEC) emerged as a powerful organization, having one overriding goal: limiting its production of crude oil in order to obtain a higher price and prolong supply. The goal was achieved by OPEC production quotas as well as by drastic production curtailments in 1973-74, 1979, and 1980. The effect was devastating: during the 1970s, world oil prices grew rapidly. The second development which altered relationships were the major new efforts made by the government to deal with the new environment of higher prices and supply disruptions.

Price and allocation controls on petroleum products were instituted and maintained throughout the 1970s. Public transportation systems were defined as priority distillate products users, eligible for 100 percent of current fuel requirements. However, in early 1981, the Federal Government eliminated all price and allocation controls.

Oil Markets in the 1980s

The U.S. has reduced both its overall energy use and its dependence on imports. Refer to Figure E.1, which shows a 1977-1979 peaking at about seven billion barrels annual consumption, with 48% imported. The years 1977 through 1979 were the culmination of a steady growth in oil use and oil import reliance (as well as overall energy consumption, not shown in the figure). Only in 1974-75, the years immediately following the 1973-74 Arab Embargo, was growth in all these areas somewhat arrested.

Since 1980, however, there have been significant changes. These are not simply the effects of an economic recession. Current total energy consumption (including all energy sources) is off by ten percent from its peak level, falling below 71 quadrillion BTU's for all of 1982. Petroleum consumption has decreased more: in 1982 it was 5.6 billion barrels, nearly 19 percent below its peak 1978 level. Finally, and most dramatic of all, petroleum imports have fallen to 1.8 billion barrels for 1982, representing one-third of U.S. needs and a 44 percent drop from the peak 1977 level. Figure E.2 illustrates this.

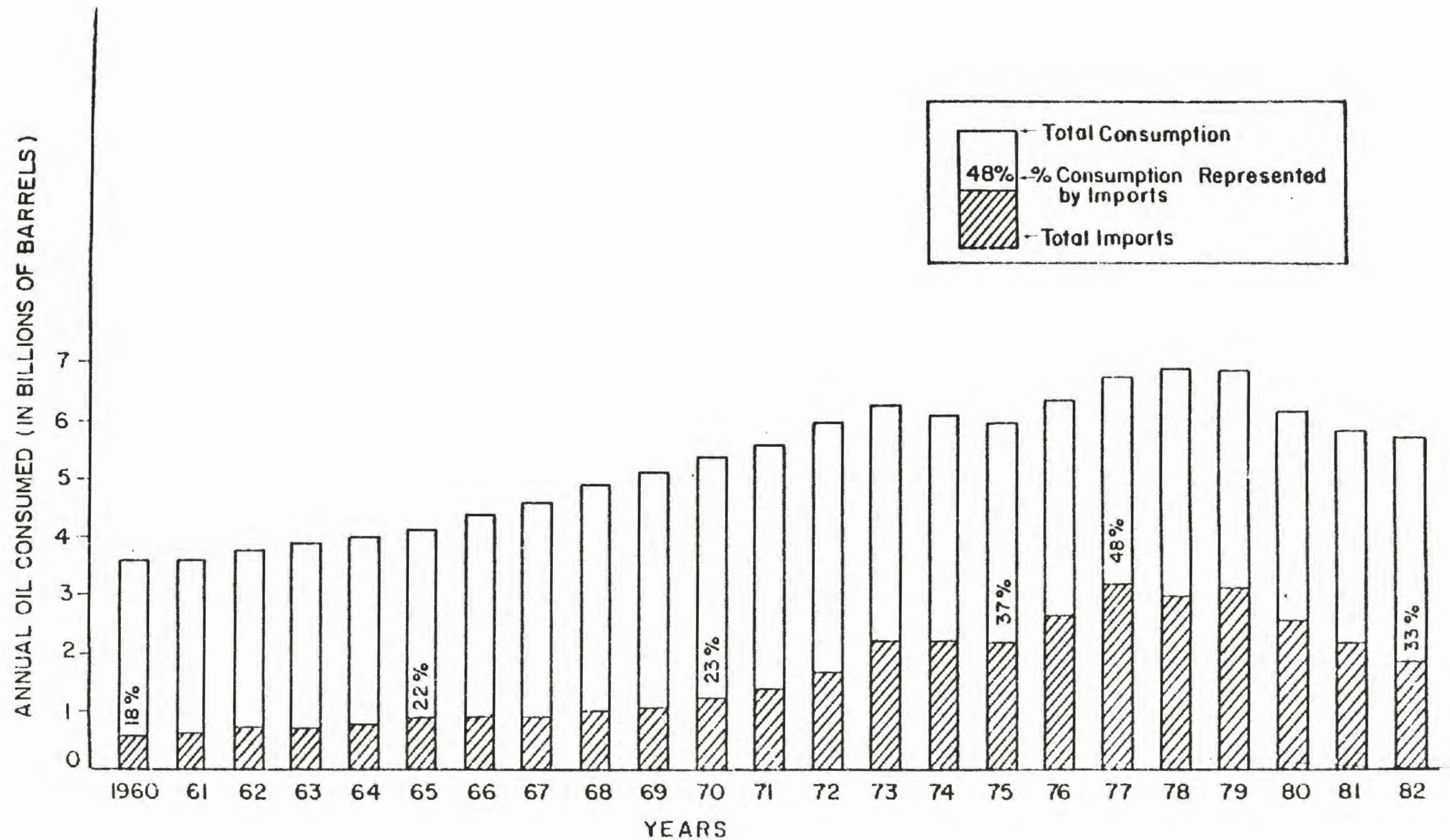
Recall that the common denominator of energy measurement is the BTU, or British Thermal Unit. Total energy consumption is frequently expressed on this basis, whereas oil consumption is frequently expressed in barrels of oil, each containing on the order of six million BTU's.

Some 300 transit systems in the U.S. consume nearly ten million barrels of diesel fuel annually. That represents 98 percent of bus transit energy consumption; gasoline and propane make up the remaining two percent.

Transit Systems and Diesel Fuel Suppliers: How They Interact

There are four basic areas in which interactions occur between all oil consumers and suppliers. These are the following:

1. Long-term contractual agreements for fuel supply.
2. Short-term spot market agreements for fuel supply.
3. Hedging against uncertain fuel price and supply conditions in the commodity futures market.
4. Maintaining fuel inventory for normal or emergency purposes.




Source: USDOE, 1982 Annual Energy Review, April 1983.

FIGURE E.1

U.S. OIL CONSUMPTION AND IMPORTS: 1960-1982

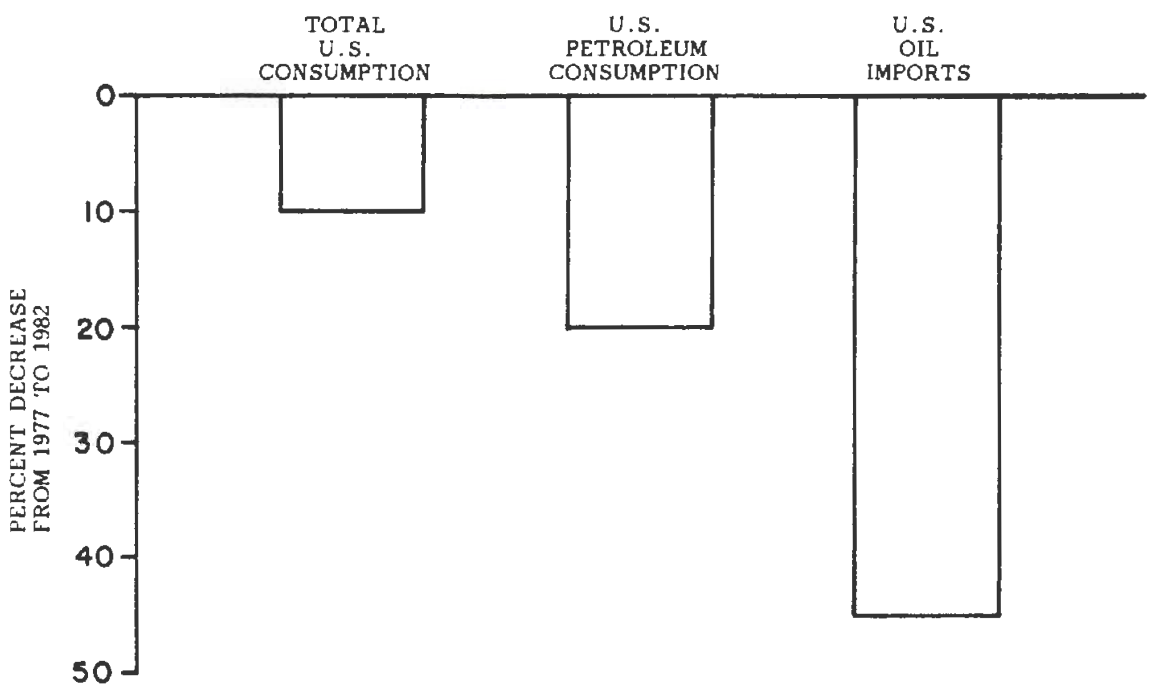



FIGURE E.2

RECENT DECREASES IN U.S. ENERGY CONSUMPTION

All of these have been affected by deregulation: a) in a direct manner by the actual removal of price and allocation controls, and b) indirectly by the change in oil production and consumption patterns which deregulation has helped to create. Although deregulation and its aftermath has set the stage for basic changes in these areas, there has been exhibited some resistance to change. Transit properties, on the whole, are among those which have not instituted much change in the way they typically purchase and store their fuel. It is useful to examine what has changed and what has not, and how this relates to the overall concept of uncertainty.

Except for a few notable cases, few other transit systems are pursuing the types of cost-saving or budget stabilizing changes related to contractual fuel agreements which deregulation has allowed. Why are transit systems foregoing cost-savings in favor of maintaining pre-deregulation relationships? Perhaps the strongest reason is that transit systems, faced with the loss of the supply certainty afforded them by regulation see the longstanding traditional fuel contract as an important means of restoring some measure of certainty. As a contingency measure, transit systems want to maintain a long-term, high-volume relationship with a supplier, with the expectation that government- or supplier-imposed allocation procedures will be reinstated during a disruption. These measures, which are intended to reduce uncertainty through better supplier relationships, have one particular imperfection. They have not yet been tested under the strain of an oil disruption within a free-market setting.

Transit systems are pursuing one major action which minimizes spot market utilization. Transit systems keep a close review over their diesel fuel suppliers. Review begins at the time of fuel contract solicitation, with an inquiry as to the source of supplies of all bidders and an informal survey among area diesel consumers to check the supply reliability of new bidders. (Fuel quality issues may also be checked.) Although it is not normally a contract requirement that fuel supplies emanate either from domestic sources or a major oil company, transit systems do at least attempt to define the supply chain and evaluate its reliability prior to awarding of contracts. The reason for the review is to reduce supply uncertainty. Firmly established supply chains are heralded as an important way in which to insure against fuel cutoffs during oil disruptions (17). Obviously, direct or indirect spot market purchases clash with this concept of reducing supply uncertainty, and it is primarily for that reason why transit systems generally avoid the spot market.

Uncertainty creates commodity markets and futures contracts. When there is lack of certainty about price and supply, there are suppliers and consumers who desire to hedge against future misfortune. The heating oil futures market (in New York and Chicago) is utilized by refiners, jobbers, large-scale consumers, and speculators. Why should diesel fuel users be concerned with heating oil futures? The two products are very similar. Under extreme circumstances, diesel fuel consumers could take delivery on heating oil futures contracts, although post-delivery additives would probably be required. There are, however, enough other disadvantages to taking delivery that normally this is a weak reason. The more important reason is that the market prices of heating oil and diesel fuel are closely related. Therefore, transit systems can hedge, with relative assurity, against diesel fuel price increases by using heating oil futures contracts.

In practice, however, only a very few transit systems have entered the futures market. A basic reason is that many diesel fuel users (most notably transit systems, but also including trucking firms and railroads) have had little experience and little incentive to engage in fuel price protection. Transit systems have not paid much attention historically to financial considerations of fuel purchasing. To the extent that such considerations have taken hold, they have resulted in changes to the actual fuel supply contract itself. There is a pervasive lack of understanding and wariness among most transit systems concerning extra-contractual arrangements such as the future market. The incentives to explore price protection are far outweighed by the perceived cost and risks of the futures market.

In 1980, a significant effort was made to increase storage facilities and supplies for contingency purposes. Some transit properties have done so, generally constructing larger fuel storage tanks at new garage facilities and in some instances expanding existing storage facilities. Among the most ambitious was the Seattle METRO system, which first began to lease extra storage capacity in 1979 and in 1982 purchased a former tank farm and began converting it into a diesel fuel storage facility. It is intended that the tank farm hold 90 days supply. But in practice, the storage contingency plans of most transit systems have not survived the economic influences which now favor reduced inventory. Many transit systems continue to operate with minimum inventories. Others have deferred purchasing additional storage capacity because of the changed economic picture. By 1983-84, even Seattle METRO has considered alternative uses for its storage facility, including using it as a daily operations fuel distribution center.

## Likely Effects of Future Oil Disruptions On Transit Systems

There is a spectrum of uncertainty with regard to potential oil disruptions occurring in an unregulated, market-oriented environment. The intensity and duration of disruptions is likely to be dependent upon a number of factors, only one of which is the actual loss of oil production. There are two main viewpoints with regard to product supply during an unregulated disruption: a) that products will be available to all who can afford them, or b) that various factors will force suppliers to allocate products to consumers, thereby equitably distributing a shortage. Along with these two supply theories go divergent price implications: a) in the market theory, prices will rise to equilibrium levels rather quickly, with the new, relatively high price accurately reflecting new demand/supply conditions, and b) in the institutional theory, prices rise slowly and unevenly, reflecting contractual and other oil industry factors at play. Finally there is no certainty as to <u>how</u>, <u>when</u> or even <u>if</u> the Federal government would intervene with the few actions it has available currently: namely Strategic Petroleum Reserve (SPR) oil release, International Energy Agency (IEA) participation and economic response measures.

Within this uncertainty framework, therefore, how can the effects of future oil disruptions on transit systems be predicted? Rather than attempt to develop a firm answer to this question, it was felt that it would be more appropriate and effective to use an alternative scenario approach. Two scenarios were developed: minor and moderate disruptions. (Major disruptions encompass far-reaching impacts and would necessitate major Federal policy actions, all of which transcend the fuel supply or price concerns of transit properties, and these are not addressed in the present work.)

There are no set definitions of either minor or moderate disruptions, although generally a seven percent loss in free world oil production is considered the dividing line between the two. The scenarios used in this work reflect the differences between the market and institutional viewpoints. Table E.1 summarizes the basic characteristics of these disruption scenarios as presented above.

What will happen to product supply during a disruption? The market viewpoint is that while a shortfall would be apparent, shortages are avoidable. Products would be available in sufficient supply to meet the new, lower demand (reduced by higher disruption prices). The institutional viewpoint is that shortages are likely for two reasons: a) relatively low prices will not reduce demand to any great extent (and, in fact, will cause increased demand for inventory purposes); and b) due to the imbalance in demand and supply, product distributors are likely to allocate supplies to consumers.

In terms of the scenarios, these viewpoints translate into the following:

- in the market scenarios, transit systems can look forward to receiving all their diesel fuel supplies, as long as they can pay for them. No shortages should occur throughout the duration of the disruption;

- in the institutional scenarios, transit systems can look forward to receiving only a portion of their diesel fuel supplies. The best estimate of what portion will be available is the amount of overall petroleum supplies available to the U.S. throughout the duration of the disruption (i.e., in the scenarios used here, transit systems would be allocated 93 and 75 percent of their normal supplies during minor and moderate disruptions, respectively.

The market viewpoint holds that new equilibrium prices will be reached relatively quickly during a disruption and that these prices will be considerably higher than current prices (i.e., on the order of 75 and 180 percent higher during minor and moderate disruptions, respectively). Prices then fall when the disruption ends and production is restored.

The institutional viewpoint holds that prices rise slowly during a disruption and continue to do so even after the disruption ends. However, in this viewpoint, prices never reach the levels recorded in a pure market setting.

## Identifying Alternatives for Relieving Disruption Impacts

The alternatives represent in themselves only a subset of any number of possible ways in which transit systems could be assisted during disruptions. The alternatives chosen represent the most currently feasible actions which can be expected to occur, based on a) past experience, b) policies and plans of government agencies, and c) notable proposals by interested parties.

### Continuation of Current Fuel Procurement Procedures (Circa 1984)

This alternative is a continuation of the current long-term, price-adjusted contract and minimum inventory procedures which most transit systems adhere to in the normal procurement of diesel fuel supplies.

TABLE E.1

SUMMARY OF BASIC DISRUPTION SCENARIO CHARACTERISTICS

| Scenario Size | Characteristics | Scenario Types: Market | Scenario Types: Institutional |
|---|---|---|---|
| Minor | 1. Free World Production Loss | 1.2 million barrels daily | 2 million barrels daily |
| | 2. U.S. Disruption Impact: | | |
| | a. Import Loss | 1.2 million barrels daily | 760,000 barrels daily |
| | b. New Inventory | N.A. | 300,000 barrels daily |
| | 3. Total U.S. % Loss | 8% | 7% |
| | 4. Duration | 1 Year | 1 Year |
| | 5. Likelihood | Embargo unlikely, thus U.S. losses likely to be lower. Year-long disruption unlikely. | Duration and new inventory likely to be lower in current demand environment. In tight market, very likely scenario. |
| Moderate | 1. Free World Production Loss | 5 million barrels daily | 6.5 million barrels daily |
| | 2. U.S. Disruption Impact: | | |
| | a. Import Loss | 2.3 million barrels daily | 2.29 million barrels daily |
| | b. New Inventory | N.A. | 1.6 million barrels daily |
| | 3. Total U.S. % Loss | 15% | 26% |
| | 4. Duration | 1 Year | 1 Year |
| | 5. Likelihood | SPR non-release questionable. Likely tight market scenario. | SPR non-release questionable: if fully released, impacts would be less than minor disruption. Smaller SPR release likely, possibly eliminating new demand. |

N.A. = Not Applicable
SPR = Strategic Petroleum Reserve

Federally Mandated 100 Percent Allocation of Supplies to Transit Systems

This would mean the return of Federal regulations which existed in the 1970s. Public transportation systems would be guaranteed 100 percent of their diesel fuel needs. Under this mandate, the Federal government does not actually transfer fuel products to those transit systems in need, but rather issues certificates to transit systems which allow them to request and receive additional fuel from regular (or even new) suppliers.

Use of the Strategic Petroleum Reserve (SPR)

The SPR alternative would be used primarily to direct most of what is likely to be a limited drawdown of SPR supplies to those parties which the market (or the Federal government) determines to be the most needy. However, a small amount of available SPR fuel could be directly sold to meet the needs of the nation's transit systems. For instance, the Federal government could directly sell up to ten percent of SPR released fuel to transit systems who in turn could sell it to their suppliers for conversion into diesel fuel to be used exclusively by transit systems.

State Set-Aside Fuel Allocation to Transit Systems

Chapter 2 of the report describes the objectives of the federally-created state set-aside programs of the 1970s and Chapter 4 notes that in the absence of any current Federal program, about 25 states have created or are actively considering reinstating such programs. In 1983, a conference of government and oil market officials agreed that a state set-aside program could be a useful tool to respond to hardship cases during oil disruptions. State Governments would be allowed to claim a certain percentage of various fuels being sold in the state. The percentage is likely to vary between two and five percent. The fuels will vary also but will likely include diesel fuel. As with the Federal allocation alternative, under the state set-aside program no fuel actually is transferred physically to the state. Instead, on a monthly basis, the state grants certificates to consumers allowing them to purchase a specified additional amount of fuel from their current (or even a new) supplier. The total amount of fuel designated by such certificates is limited to the specified set-aside percent. States could easily designate transit systems as the highest priority, capable of receiving all their needs within the constraints of the set-aside percentage.

New Fuel Procurement Procedures

This alternative involves the employment of innovative fuel procurement procedures. While there is room for improvement and innovation in many areas of fuel procurement, this work is concerned with three particular areas:

1. Purchase of fuel through cooperative agreements;

2. Entry in the heating oil futures market;

3. Building a reasonable contingency inventory, modified by economic conditions.

### Emergency Assistance Measures

Extraordinary emergency measures would have to be adopted in order for transit systems to adequately function during long supply disruptions. These measures include the following:

1. Subsidies and/or fare increases to cover increased fuel costs;

2. Service cuts or readjustments in response to fuel supply reduction and/or cost increases;

3. Shifts to lesser quality fuel.

The one likely source for subsidy aid would be through temporary Federal block grants to the states. Block grants are one of a number of standby economic response measures under consideration by the Federal government, as of this writing (1983-84). State governments would use the block grants at their discretion, although likely recipients would include transit systems with higher costs and greater responsibilities during disruptions. Funding for the programs would likely come from one or both of the two sources of Federal income expected to increase during a disruption: the oil windfall profits tax and/or sales receipts from released SPR oil.

## Evaluating the Alternatives

All six alternatives were evaluated against three groups of criteria:

- Uncertainty
- Transit Service
- Secondary Impacts

The results of these evaluations are summarized in Figures E.3 and E.4, and described in this section.

### Uncertainty Evaluation

Seven separate uncertainties were defined for use as a basis for evaluation. These are:

1. A disruption may occur immediately, at some later undertermined time, or never;

2. A disruption could be of minor or moderate magnitude. (Overwhelming disruptions are not considered in this work because their impact and the required responses would so totally transcend the present topic);

3. A disruption could last for as long as a year or end at a considerably earlier time;

4. A disruption could produce regular supply shortages to consumers or no shortages;

| ALTERNATIVES | MINOR DISRUPTION — EFFECT OF ALTERNATIVES ON PRICE IMPACTS | MINOR DISRUPTION — EFFECT OF ALTERNATIVES ON SUPPLY IMPACTS | MODERATE DISRUPTION — EFFECT OF ALTERNATIVES ON PRICE IMPACTS | MODERATE DISRUPTION — EFFECT OF ALTERNATIVES ON SUPPLY IMPACTS |
|---|---|---|---|---|
| 1.CURRENT PROCUREMENT | | | | |
| - CONTRACTS | ○ | ○ | ○ | ○ |
| - SPOT MKT. | ○ | ◑ | ○ | ◑ |
| 2. FED. ALLOCATION | ○ | ● | ○ | ● |
| 3. SPR RELEASE | | | | |
| - AUCTION | ◑ | ◑ | ◑ | ◑ |
| - DIRECT SALE | ○ | ● | ○ | ● |
| 4. STATE SET - ASIDE | ○ | ● | ○ | ● |
| 5. NEW PROCUREMENT | | | | |
| - FUTURES MKT. | ◑ | ◑ | ◑ | ◑ |
| - INVENTORY | ◑ | ● | ◑ | ◑ |
| - OTHER | ○ | ◑ | ○ | ◑ |
| 6. EMERGENCY ASSIST. | | | | |
| - SUBSIDIES | ● | ● | ● | ● |
| - FARE INCREASES | ● | ● | ● | ● |
| - SWITCH TO #2 | ◑ | ◑ | ◑ | ◑ |

○ Completely Ineffective ◑ Somewhat Effective ● Completely Effective

FIGURE E.3

EFFECTIVENESS OF ALTERNATIVES AGAINST KEY UNCERTAINTY CRITERIA

| ALTERNATIVES | LEGAL AND REGULATORY STATUS | DEGREE OF COORDINATION |
|---|---|---|
| 1.CURRENT PROCUREMENT | ● | ● |
| 2.FED.ALLOCATION | ○ | ● |
| 3. SPR RELEASE | | |
| - AUCTION | ● | ○ |
| -DIRECT SALE | ● | ○ |
| 4. STATE SET- ASIDE | ● | ○ |
| 5.NEW PROCUREMENT | ○ | ○ |
| 6. EMERGENCY ASSIST. | | |
| - SUBSIDIES | ○ | ○ |
| -FARE INCREASES | ● | ○ |

● Requires little or no changes in current laws,regulations or operating procedures

○ Requires considerable changes in current laws,regulations or operating procedures

FIGURE E.4

THE INSTITUTIONAL IMPACTS OF ALTERNATIVES

5. A disruption could produce major and immediate fuel price changes or only minor and gradual fuel price changes;

6. In addition to these points there are other uncertainties which have only been briefly discussed, including:

   a. A series of disruptions could reoccur in relatively quick succession or a disruption could be an isolated event;

   b. In a related possibility, a disruption could develop slowly, with production removed gradually, or it could occur rapidly, with production cut sharply.

The optimum alternative would be fully cognizant of the whole list of uncertainties criteria and be capable of adjusting to the full range of possibilities. The worst alternative would not account for any of them and could only perform within a strict set of conditions. In reality, most alternatives fall somewhere in-between: capable of operating within a limited range of possible events.

The following conclusions can be drawn about this evaluation:

- Transit service reductions are effective under any disruption condition.

- In immediate disruptions (Circa 1984), there are no other measures that can immediately be instituted to provide both supply and price protection. If the disruption persists for some time, however, fare increases could serve those purposes. From the outset, though, Federal Allocation and State Set-Aside could provide necessary supply protection.

- In later-occurring disruptions, Federally-supported block grants are effective under most disruption conditions.

- New Fuel Procurement Procedures are worth pursuing, especially since their use is controlled by transit systems (and not uncertainties of other government actions) and are effective during non-disruption periods also. These are not panaceas but can significantly reduce adverse supply or price impacts under many possible disruption conditions.

- The SPR Release alternative has benefits, but the uncertainties of its use under slowly developing or minor disruptions represent major limitations. Besides, the supply benefits of the directed sales option are met by the other alternatives as well. Therefore, this alternative should not be considered as a direct transit assistance measure. If the auction process is implemented, it will help transit systems, just as it will help all oil consumers.

<u>Transit Service Evaluation</u>

Only the block grant subsidy and the fare increase measures allow transit systems to choose a maintaining of, or a decrease in services provided. If institutional conditions arose, then Federal Allocation, SPR Directed Sales and

State Set-Aside would do the same. A few alternatives under certain conditions would allow transit services to maintain services; namely

- SPR Auction, in post-1990, minor disruptions only;
- Futures market deliveries, under institutional conditions only;
- Reasonable inventory, under disruption and institutional conditions.

All remaining alternatives necessitate service reduction.

Secondary Impact Evaluation

The secondary impacts considered in this work are the costs of the alternatives to the various parties, the institutional concern with implementation, and impact on other consumers and on suppliers.

1. Cost Evaluation. The lowest cost measures are maintaining Current Fuel Procurement Procedures and cutting services and switching to diesel fuel #2; essentially they are no-cost measures. Federal Allocation is a very low cost alternative. Beyond these, costs are at a considerable higher level. State Set-Aside is a labor-intensive alternative but the transit component would probably be comparable to the cost of the Federal Allocation alternative. In addition, the relatively high costs of enacting SPR Release (auction and directed sales options), cooperative fuel purchasing and futures market entry should be less than either a) deferred import related costs, or b) expected revenues.

The three most expensive measures are reasonable inventory, block grant subsidies, and fare increases. The latter two would not represent a major drain on either the transit budget or riders' income, however.

2. Institutional Evaluation. Only the Current Fuel Procurement Procedures is free from institutional concerns. All other alternatives require either laws to be passed, or a high level of coordination among various parties, or both. Most are adaptable to various overall governmental responses to oil supply disruptions except for Federal Allocation, and SPR Release in minor disruptions, both of which conflict with the stated market approach of the Federal government, and fare increases/service cuts, which conflict with state level objectives of managing disruptions.

3. Oil Market Evaluation. No measure diverts a significant amount of fuel from other users. But the Federal Allocation alternative would appeal to so many users that it severely jeopordizes its acceptance as a useful measure.

The Best Package of Alternatives

The best package of alternatives includes the following measures:

1. Block Grant Subsidies. This is a crucial measure, for if no other measures were implemented, this measure would suffice under nearly all disruption conditions. Since this measure is not available immediately, transit systems should look to fare increases as a sound (if unpopular) move in the near term, but only in response to precipitous price increases (i.e., market

scenarios). In order to reduce the costs of the block grant measure (and to avoid using fare increases in imminent disruptions to make up for shortages vs. costs), other measures should accompany this one.

2. Switch to Diesel #2. Those systems using diesel #1 should switch to #2 during disruptions. The cost savings will reduce necessary block grant subsidy levels.

3. State Set-Aside. State Set-Aside programs should not be instituted for the sake of transit systems alone. But, if for other reasons, states establish set-aside programs which include distillate fuels, then transit systems should participate in them during institutional scenarios to lower block grant costs (or avoid fare increases).

4. New Fuel Procurement Procedures. Transit systems should pursue cooperative fuel purchasing objectives and investigation of, and likely entry into, the heating oil futures market. These measures, during disruptions, will provide cost saving and possible fuel supplies. This will reduce block grant costs. But in non-disruption conditions, this alternative also offers considerable cost savings possibilities. However, the reasonable (i.e., 25-day) inventory is not recommended for implementation because of cost and the existence of better alternatives.

In addition to these four measures, the use of the SPR Release (via an auction process) according to drawdown policies are determined by USDOE (e.g., minor vs. moderate disruption drawdown; conservative vs. major drawdown rate) would be helpful to transit systems, both indirectly (i.e., lower costs and shortages to all consumers) and directly (transit system fuel co-ops entering the SPR auction process). However, the SPR Directed Sales option (for transit systems) is not recommended for implementation for reasons cited below.

### What Measures to Avoid

1. Current Fuel Procurement Procedures (Circa 1983-84). This alternative is ineffective in affording almost any assistance to transit systems during disruptions.

2. Service Cutbacks. While this does directly respond to the problems which disruptions create, it conflicts with the basic purposes of providing transit service, especially during a time when automobile related mobility will be restrained.

3. Federal Allocation. State Set-Aside is substituted for this measure in the recommended package because of a number of interrelated reasons. First, Federal Allocation conflicts with current Federal energy policies and therefore, would face resistance. Secondly, that resistance is likely to be intensified as the concept of a Federal Allocation program attracts many other preferential users and hardship cases to the cause of such a program. Third, Set-Aside is in concert with Federal objectives to allow states to make their own policies on disruption planning and is in concert with the types of actions and directions which many states intend to take.

4. SPR Directed Sales. State Set-Aside is substituted for this measure in the recommended package for two reasons. First, the likelihood that the SPR will not be used at all in minor disruptions restricts this measure's effectiveness. Secondly, this measure is simply more complex than the Set-Aside measure: 1) SPR Directed Sales requires coordination among transit systems, oil suppliers, and the Federal government and necessitates refining or fuel agreements, since SPR inventory is crude oil only; 2) Set-Aside requires coordination only between states and transit systems in order to establish appropriate dispersal.

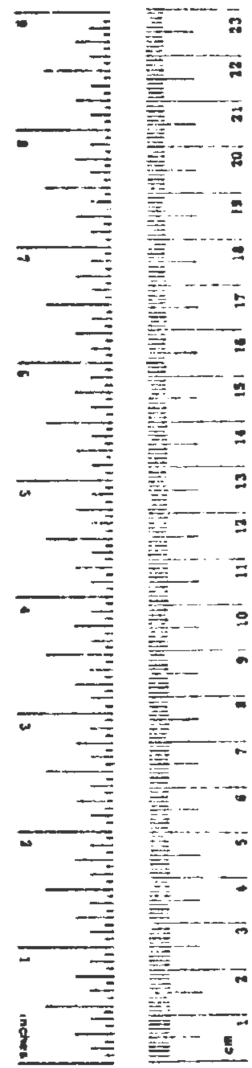
5. Reasonable Inventory. This is not recommended for two reasons. First, the cost of this measure is high. Second, its objective can be met by other recommended actions such as block grants, futures market, and State Set-Aside.

# METRIC CONVERSION FACTORS

## Approximate Conversions to Metric Measures

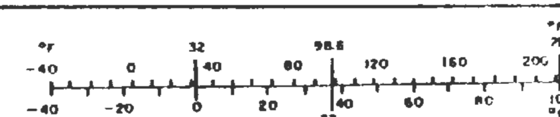
| Symbol | When You Know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | **LENGTH** | | | |
| in | inches | *2.5 | centimeters | cm |
| ft | feet | 30 | centimeters | cm |
| yd | yards | 0.9 | meters | m |
| mi | miles | 1.6 | kilometers | km |
| | **AREA** | | | |
| $in^2$ | square inches | 6.5 | square centimeters | $cm^2$ |
| $ft^2$ | square feet | 0.09 | square meters | $m^2$ |
| $yd^2$ | square yards | 0.8 | square meters | $m^2$ |
| $mi^2$ | square miles | 2.6 | square kilometers | $km^2$ |
| | acres | 0.4 | hectares | ha |
| | **MASS (weight)** | | | |
| oz | ounces | 28 | grams | g |
| lb | pounds | 0.45 | kilograms | kg |
| | short tons (2000 lb) | 0.9 | tonnes | t |
| | **VOLUME** | | | |
| tsp | teaspoons | 5 | milliliters | ml |
| Tbsp | tablespoons | 15 | milliliters | ml |
| fl oz | fluid ounces | 30 | milliliters | ml |
| c | cups | 0.24 | liters | l |
| pt | pints | 0.47 | liters | l |
| qt | quarts | 0.95 | liters | l |
| gal | gallons | 3.8 | liters | l |
| $ft^3$ | cubic feet | 0.03 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.76 | cubic meters | $m^3$ |
| | **TEMPERATURE (exact)** | | | |
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.




## Approximate Conversions from Metric Measures

| Symbol | When You Know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | **LENGTH** | | | |
| mm | millimeters | 0.04 | inches | in |
| cm | centimeters | 0.4 | inches | in |
| m | meters | 3.3 | feet | ft |
| m | meters | 1.1 | yards | yd |
| km | kilometers | 0.6 | miles | mi |
| | **AREA** | | | |
| $cm^2$ | square centimeters | 0.16 | square inches | $in^2$ |
| $m^2$ | square meters | 1.2 | square yards | $yd^2$ |
| $km^2$ | square kilometers | 0.4 | square miles | $mi^2$ |
| ha | hectares (10,000 $m^2$) | 2.5 | acres | |
| | **MASS (weight)** | | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.2 | pounds | lb |
| t | tonnes (1000 kg) | 1.1 | short tons | |
| | **VOLUME** | | | |
| ml | milliliters | 0.03 | fluid ounces | fl oz |
| l | liters | 2.1 | pints | pt |
| l | liters | 1.06 | quarts | qt |
| l | liters | 0.26 | gallons | gal |
| $m^3$ | cubic meters | 35 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.3 | cubic yards | $yd^3$ |
| | **TEMPERATURE (exact)** | | | |
| °C | Celsius temperature | 9/5 (then add 32) | Fahrenheit temperature | °F |



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# CHAPTER 1

# INTRODUCTION

## 1.1 Background

This work is concerned with the Federal deregulation of petroleum prices and supplies, and its effects on the vulnerability of public transportation systems to future oil supply disruptions. During the 1970s, when the world was rocked by three major disruptions in the flow of oil, transit systems were insulated from many of the difficulties others experienced due to direct Federal intervention. Since 1981, however, the Federal government has discontinued its interventionist role. Furthermore, if an oil supply disruption arises, it is the oft-stated policy of the current Federal administration not to reimpose former controls nor to pursue new controls (1).* [Only the possible release of crude oil supplies from the federally-owned Strategic Petroleum Reserve and possibly alleviating some of the macroeconomic hardships caused by soaring oil prices are currently considered as likely Federal actions. What led to this situation was a widescale re-evaluation of Federal controls used during earlier contingencies; the controls were judged to be at best, ineffective and at worst, contributors to the overall problem (2).] Without the special treatment afforded them in the past, transit systems must face the spectre of future oil supply disruptions from the same uncertain perspective as other petroleum product consumers.

Consumer uncertainty with regard to future unregulated disruptions is multi-faceted, but is dominated by two opposing viewpoints. Some observors state that if a disruption strikes, price will emerge as the most efficient mechanism for allocating reduced supply (3). In essence, those who can pay the new price will be able to get all the oil they desire; those who can't will reduce consumption; actual, physical shortages will not occur. Others claim, however, that contract language, commercial codes and business practices will force the allocation of reduced supplies equitably to all customers, regardless of the ability of one or more customers to pay for more supply (4). Should this be the case, actual, physical shortages will occur.

## 1.2 Statement of Problem

Public transit systems cannot simply respond to oil disruptions as any other free-market consumer would: spend more or consume less. Nearly all transit systems are deficit operations; there are few if any contingency funds available to accommodate the types of rapid and steep price increases associated with supply disruptions. Costs would have to be made up through 1) deferred maintenance, 2) delayed payments to fuel supplies, 3) fare increases and/or 4) added subsidies. The first option would jeopardize normal services, since deferred maintenance is a practice which results in decreased service reliability and potentially higher costs later on, and is already a past practice

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* The notes and citations for each chapter are shown as a set after the last chapter.

now being remedied in some cases. The second option could severely threaten current fuel supplies and assuredly place the transit system in a poor bargaining position in future fuel contract agreements. The last two options are subject to the many institutional strictures which currently cause fare and subsidy increases to be long, protracted procedures. Neither is responsive to contingency funding needs.

Alternatively, transit systems could consume less fuel, but only through reducing or significantly altered services. Oil disruptions have been shown to be boom periods for transit demand, as a portion of private vehicular users switch over to public transportation. It is crucial for transit systems, therefore, to maintain pre-disruption levels of operations and possibly supplement them with expanded services to meet added demand.

## 1.3 Objectives of This Work

This work has two related objectives. The first is to analyze the full range of uncertainty that oil deregulation has created for public transit systems as a prelude to the event of another oil disruption. Second, this work formulates, evaluates and recommends various options that may be implemented to reduce uncertainty among public transit systems.

## 1.4 Methodology and Organization of this Work

### 1.4.1 Uncertainty Analysis

The first objective of this work, to analyze transit uncertainty created by oil deregulation, is met via a progressive analysis of oil consumer and supplier relationships in the United States, described in Chapters 2 through 5. The first step in this analysis is an overall review of oil markets, found in Chapter 2. Here is discussed how petroleum consumption, supply and regulation evolved from the beginning of this century through the turbulent 1970s up until the early to mid-1980's. The significant Federal regulatory efforts of the 1970s are highlighted. The abrupt turn-around in oil consumer/supplier relationships in the 1980s is discussed within the perspectives of Federal deregulation, price-induced consumer conservation and worldwide oil production shifts. One particular segment of petroleum products, distillates, is focused upon, for a number of reasons. First, it is a growing segment of refining operations. Second, it includes both transportation and other user types (particularly residential). Third, it has experienced significant changes in consumption, supply and regulatory patterns since 1970. Fourth, one of the distillates is diesel fuel, by far the single most important fuel for public transit buses.

The next step is the analysis of the specific relationships and mechanisms by which public transit systems currently obtain and utilize their diesel fuel requirements from suppliers. Chapter 3 contains this analysis. Four institutions of oil markets are explored in detail: contracts, the spot market, the commodity futures market and inventory practices. In performing this analysis, information from a sample of the nation's transit systems is utilized, obtained primarily through personal interviews with transit fuel procurement officials, but also from existing literature sources.

The third step, described in Chapter 4, is an analysis of what generally can be expected to occur during future oil supply disruptions. Four questions are posed:

1. What will disruptions be like?
2. What will happen to product supply?
3. What will happen to product price?
4. What role is government likely to take?

The analysis is based on the events which occurred in prior disruptions of the 1970s, as well as on the views expressed by oil industry representatives, government officials (both collected via personal interviews) and the current literature. The analysis indicates that scenarios are the clearest and most reliable manner in which to understand future disruption conditions. Scenarios are based on the likely magnitude of disruptions as well as on the likely emergence of either market or institutional factors as determinants of supply and price conditions.

The last step in the analysis is an assessment (described in Chapter 5) of the specific effects likely oil supply disruptions would have on public transit systems. The scenarios generally described in Chapter 4 are formalized into four distinct models with explicit supply and price consequences. These models, derived from the existing literature, represent the range between relevant magnitudes of disruption (i.e., minor and moderate levels) and between the importance of market vs. institutional factors. The implications for diesel fuel price and supply are revealed. Then, using six large and moderately sized transit systems as a cross-section of the nation's transit industry, the following impacts are derived:

1. Impact on fuel costs;
2. Impact on annual fuel budget;
3. Availability of fuel supplies;
4. The cost and supply impacts of maintaining the current level of bus services;
5. The cost and supply impacts of increasing the level of bus services to meet areawide contingency needs.

1.4.2 <u>Options for Reducing Uncertainty</u>

The second objective of this work, to identify, evaluate and recommend options that reduce the disruption-related uncertainty that oil deregulation has created for transit systems, is met in the material presented in Chapters 5, 6 and 7. Chapter 5 provides an extensive identification of six available options, namely:

1. Continuation of current fuel procurement procedures.
2. Federally mandated 100 percent allocation of supplies to transit systems.
3. Use of the federally-controlled Strategic Petroleum Reserve in a) a general release format or b) a directed sales format.
4. State set-aside fuel allocation to transit systems.
5. New fuel procurement procedures.
6. Emergency assistance measures.

Each alternative option is then evaluated (in Chapter 6) against three groups of criteria. The first group of criteria used are the so-called uncertainty criteria: given that so many characteristics of a future oil supply disruption are unpredictable, the adaptability of the various options to an identifiable range of likely outcomes is an indication of their utility. The second group of criteria used are the transit service criteria: to what extent does an option allow a transit system to maintain or even increase its level of bus service during disruptions? The third group of criteria used are secondary inpact criteria; these include the costs of the various options, the institutional concerns for each option and the impacts of each option on other oil consumers and on diesel fuel suppliers.

Out of this evaluation process emerges a package of recommended options, presented in Chapter 7. Along with these recommendations are suggested approaches to implement these options quickly in the event of an oil supply disruption so as to maximize their effectiveness. Inherent within the implementation process is a need for further research efforts which should be undertaken in order to better inform and prepare individual transit systems on the impacts of oil supply disruptions and options available to alleviate those impacts.

# CHAPTER 2

# THE OVERALL STATUS OF U.S. OIL MARKETS

## 2.1 Oil Markets Before 1970

The oil supply-consumption chain is well-established and pervasive throughout the modern American economy and society. Consumers range from individual home owners to electric utilities; from automobile owners to large land, air and sea vehicle fleets; from farms to heavy industry. Suppliers include America's wealthiest corporations (most of them fully integated, controlling processes from crude oil extraction to the gasoline pump); many more smaller, independent producers, importers, refiners, distributors, transporters and marketers; and a multitude of small, local dealers of home heating fuel and motor fuel products. Governments at all levels impose taxes on crude and product sales and regulate commerce of oil in various ways.

All of these components have been in-place for many years. Household consumption of oil products began in the 1860s (i.e., kerosene for lamps). By 1913, there were one million automobiles and industry was switching from coal to oil usage (1). Full integration of oil supply processes thrust the Standard Oil Company forward in the late 19th century as one of history's most important corporations. Its successors and competitors emerged by the second decade of the twentieth century, each maintaining control over most aspects of supply (2). The niches established for independent firms specializing in one or more supply aspects were nearly all in existance by the end of World War I. Finally, as early as the 1920s the Federal Oil Conservation Board was established to study ways of regulating wasteful oil production methods; by the 1930s the Interstate Commerce Commission and the Texas Railroad Commission were actively involved in this and other forms of regulation (3).

## 2.2 Oil Markets in the 1970s

In the 1970s, however, two related developments altered the relationships among suppliers, consumers and government. First, the Organization of Petroleum Exporting Countries (OPEC) emerged as a powerful organization, having one overriding goal: limiting its production of crude oil, in order to obtain a higher price and prolong supply. The goal was achieved by OPEC production quotas as well as by drastic production curtailments in 1973-74, 1979 and 1980. The effect was devastating: during the 1970s, world oil prices grew rapidly. In the U.S., where lower prices generally reigned, domestically produced crude oil prices still rose by nearly 250 percent in constant (1972) dollars (4). What made the situation appear more unsettling was that from 1890 up until 1970, the constant price of U.S. domestic crude oil had risen by only 7 percent (5).

The second development altering relationships were the major new efforts made by the government to deal with the new environment of higher prices and supply disruptions. These efforts began in 1971 when, as part of an overall Federal policy to control inflation, prices of domestic crude oil and refined products were first frozen and later subjected to fixed increases. Following the Arab Embargo and OPEC production cutbacks of late 1973-early 1974, these price controls were made even more restrictive. At the same time, various supply allocation procedures were set up by the newly created Federal Energy Office. These included:

- the crude oil buy/sell regulation, requiring refiners with crude supplies in excess of the national average to sell, at fixed prices, their excess to refiners who were crude short.

- distillate fuel allocation regulations, allowing priority users to be provided with all their current requirements and other users a varying percentage of either current needs or the amount used during a similar time period in 1972.

- gasoline allocation regulations, allowing priority users to be provided with all their current requirements and other wholesale and bulk purchasers 100 percent of the amount used during a similar period in 1972. Retail purchasers at gasoline stations were unregulated.

- state set-aside programs for distillate fuels and gasoline, allowing each governor to skim off 3 percent of monthly supplies sold in the state and re-allocate as each state saw fit to relieve emergency or hardship conditions.

Supply problems eased by early 1974, but many of the regulations remained in place. Crude oil price controls and buy/sell regulations remained. To these was added the entitlements program, which required refiners with access to crude oil costs below the national average to reimburse (through a complex procedure) those refiners with crude oil costs above the national average. The obvious goal was to equalize crude oil costs nationwide. But the effect was to spur development of small refining operations, few of which were efficient producers of gasoline or distillate fuel (6).

Price and allocation controls on petroleum products were also maintained. Eventually, however, some of these controls were lifted and replaced with equivalent standby regulations. The price and allocation controls on distillate products for example, were changed to standby status in July of 1976. (By the time full deregulation arrived in 1981, only gasoline and propane were regulated with active controls.) But the standby status of regulations on the other products, as well as the fear of another disruption, had sufficient power to limit the amount of readjusting that might have occurred among refiner-distributor-consumer relationships. Refiners and distributors were reluctant to accept new customers, fearing that, given a disruption, they would then be forced to allocate scarce resources among a wider number of users, meaning less for everyone. Consumers (and distributors too) were reluctant to use new suppliers, reasoning that if standby regulations were reimposed with 1972 base year consumption as the standard, then they would be left with no secure source of supply during a disruption.

When the Iranian crisis began to emerge in early 1979, crude oil and gasoline controls were still in place. These were adjusted over the next few months to reflect changes that had occurred over the past five years, as well as to avoid perceived inequities of how the previous disruption was regulated

(7). Various voluntary measures were also instituted by the Federal government: avoidance of spot market purchases, building refiners' distillate product stocks, serving distillate fuel priority needs. Although unconstrained by specific regulations, most distillate product refiners and distributors allocated short supplies equitably among regular customers (rather than auction them off to the highest bidders) (8). The reason for doing this was to avoid the real possibility of reimposition of standby price and (more cumbersome) allocation regulations for distillate products.

However, voluntary allocation on an equitable basis clashed with the Federal request for refiners to serve distillate fuel priority needs. As a resolution, two regulations were imposed:

- state set-aside programs for distillate products, similar to the 1973-74 programs but with an increased allowable "skim" of 4 percent (vs. 3 percent in 1973-74).

- priority distillate products users were established, under Special Rule No. 9, exempt from equitable procedures and eligible for 100 percent of current fuel requirements. Originally, priority users were agricultural consumers, then the definition was expanded to include truckers moving perishable farm products, public transportation, and oil and natural gas producers. Finally, all users but public transportation were dropped as priority users.

Special Rule No. 9 allowed public transportation systems (and other priority users, while they were included) to demand, in the event that normal supplies were reduced, additional fuel from their suppliers, who in turn could legally demand fuel from other sources of supply, if their own supplies were short. All of this was to be procured at non-discriminatory prices (9).

As in 1973-74, virtually all these regulations remained after the supply disruption ended (some were revised, however). In September, 1980 the Iran - Iraq war broke out, causing a 60-day worldwide reduction in crude oil production of 6 percent (greater than the 1979 disruption). However, worldwide inventories were so high that little disruption in product supply (and little change in price) occurred (10). The U.S. adopted no new regulatory controls and, in fact, during late 1980 eased many existing controls.

On January 21, 1981, the Reagan Administration eliminated nearly all price and allocation controls. On the last day of March, 1981, Special Rule No. 9 and state set-aside programs for distillate products were eliminated.

## 2.3 Oil Markets in the 1980s

This section examines all overall oil supply and consumption patterns since 1980. Although deregulation occurred a year later in 1981, most of the significant changes in supply/consumption patterns began to emerge a year earlier. While deregulation certainly accelerated these developments, especially in the U.S., the patterns formed in 1980 were largely spurred on by worldwide recession and price-induced energy conservation.

This section focuses on the oil supply-consumption chain at two levels of perspective: a) from an overall oil use standpoint and b) from the standpoint of distillate product use.

### 2.3.1 Total Oil Overview

The U.S. has in recent years reduced its overall energy use, petroleum use, and level of petroleum imports. The peak levels of usage for these three indicators was as follows: a) in 1979, nearly 79 quadrillion BTU's of total energy were consumed, b) in 1978, nearly 6.9 billion barrels of petroleum products were consumed, representing 49 percent of the nation's total energy usage; and c) in 1977, over 3.2 billion barrels of crude oil and petroleum products were imported into the U.S., representing 48 percent of total oil consumed (11). As Figure 2.1 indicates, the years 1977 through 1979 were the culmination of a steady growth in oil use and oil import reliance (as well as overall energy consumption, not shown in the figure). Only in 1974-75, the years immediately following the 1973-74 Arab Embargo, was growth in all these areas somewhat arrested.

But since 1980, all three measures have declined. Current energy consumption is off by 10 percent from its peak level, falling below 71 quadrillion BTU's for all of 1982 (12). Petroleum consumption in 1982 was 5.6 billion barrels, nearly 19 percent below its peak 1978 level (13). Finally, and most dramatic of all, petroleum imports have fallen to 1.8 billion barrels for 1982, representing one-third of U.S. needs and a 44 percent drop from the peak 1977 level (14).

The reasons for the decline are multi-faceted.* Recession was a major factor, as is energy conservation. Fuel switching (primarily to coal) has helped lower oil use, while increased domestic crude oil production has helped reduce import levels. To some extent, price and allocation decontrol was important too. First, within a month of the decontrol action on January 21, 1981, the price of domestic crude and various refined products rose quickly, essentially to the world level (15). This encouraged further conservation and fuel switching, as well as increased U.S. crude production. Second, allocation regulations had affected consumption levels even after supply became plentiful. The reason for this was that in the event of a future oil supply disruption, the regulations stipulated that most (non-priority) consumers were to receive some percentage of a base year's consumption level. Therefore, an important way for consumers to insure against near-term oil disruptions was to maintain high consumption levels since the current period might serve in the future as a base year. With the removal of allocation controls, this incentive to maintain high consumption levels was eliminated.

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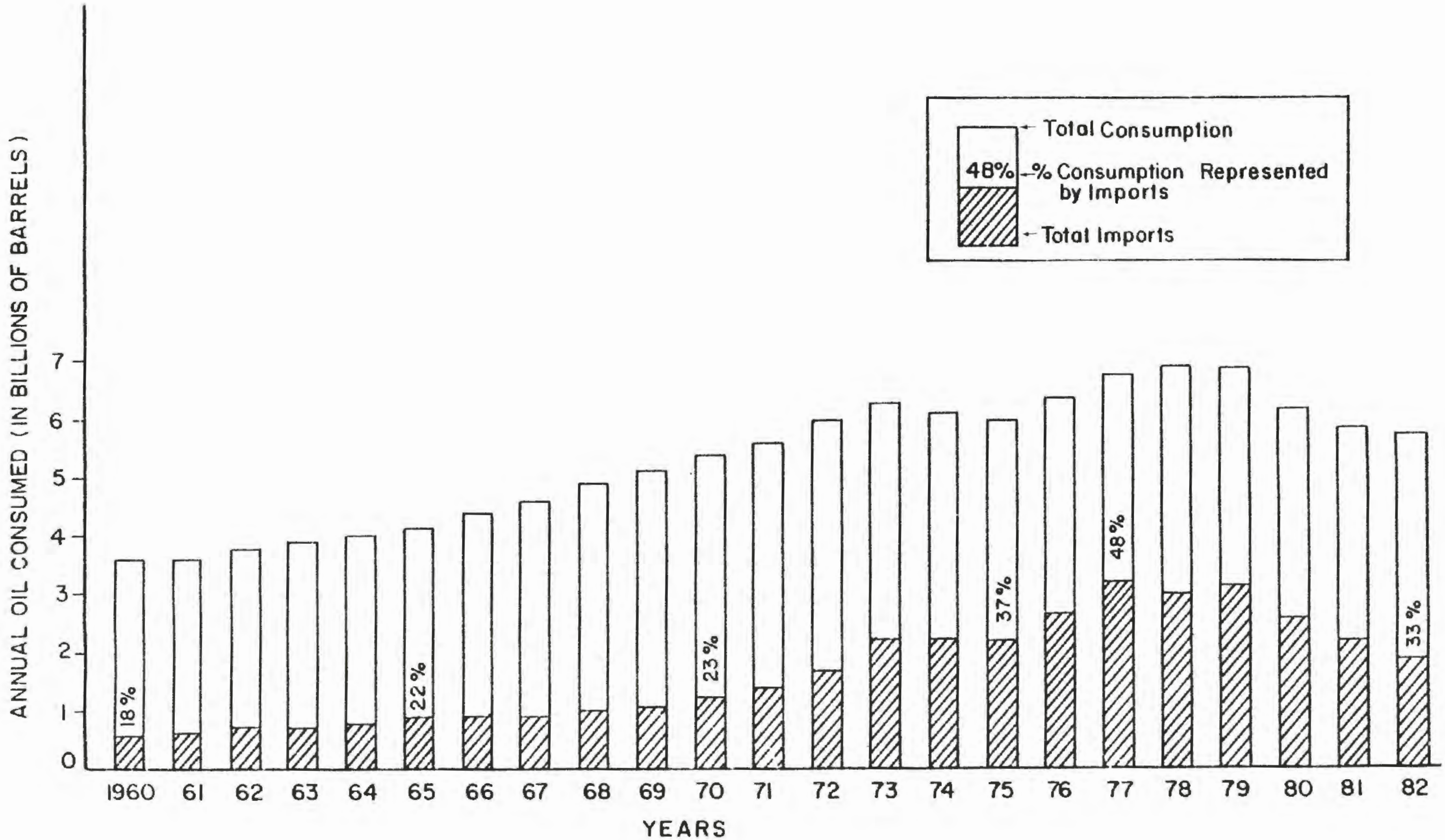
* It should be noted that the decline in consumption is somewhat related to semantics. The U.S. Department of Energy doesn't actually measure consumption, but rather the level of products supplied to consumers (taken from sales records of suppliers). These data indicate that a decline has occurred. However, as interest rates climed in 1981 and 1982, many large product distributors and consumers reduced historical inventory levels, converting those supplies into actual products consumed and substituting for new purchases. However, this discrepancy in data terminology does not account for a significant amount of the reduction in petroleum products supplied during 1981 and 1982. What it simply suggests is that actual consumption has not fallen off quite as much as the available data indicate.




Source: USDOE, 1982 Annual Energy Review, April 1983.

FIGURE 2.1

U.S. OIL CONSUMPTION AND IMPORTS: 1960-1982

The current overall status of oil consumption in the U.S. is characterized as follows:

- One third of all petroleum products are consumed by Atlantic Coast states. Regional consumption declines as one moves westward, as Figure 2.2 shows.

- The transportation sector consumes nearly three-fifths of all oil products. It comes as no surprise, therefore, that gasoline and jet fuel comprise nearly half of all oil products consumed in the U.S. But as Figure 2.3 shows, the transportation sector consumes significant amounts of distillate and residual fuel as well.

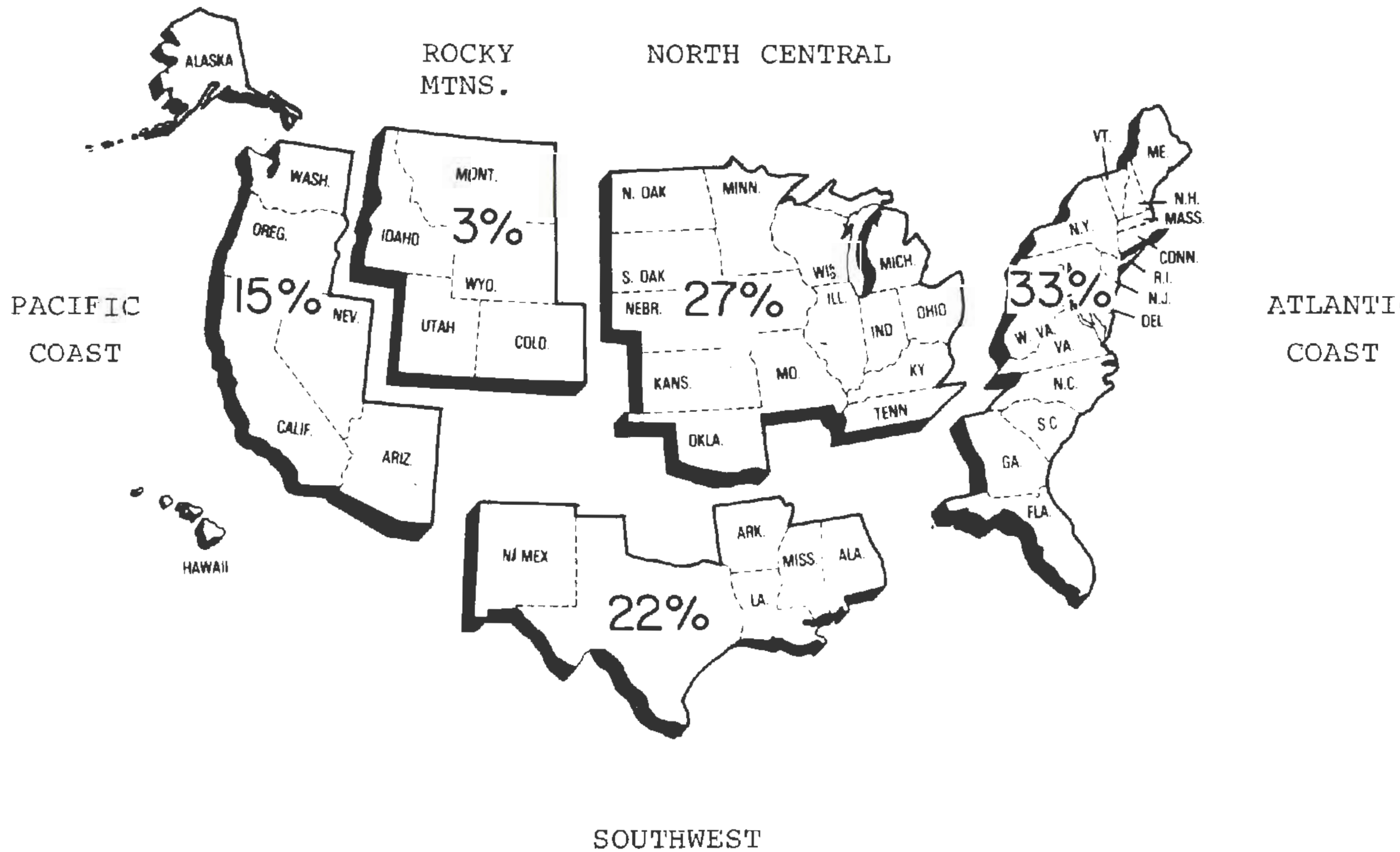
- Ten percent of petroleum products consumed in 1982 were imported from foreign refineries (16). Near two-thirds of this is consumed in the Atlantic Coast region (17). At one time virtually all imported products were residual fuel, used for electricity generation and other purposes. Since the mid-1970's, however, a substantial portion of imported products include liquified gases, distillate fuels and gasoline. Western Hemisphere nations provide nearly all of these products, particularly Carribean nations (and U.S. possessions), Canada and Venezuela (18).

The current overall status of oil supply in the U.S. is characterized as follows:

- The U.S. produced nearly 3.2 billion barrels of crude oil in 1982. On a daily basis, that was nearly 9 million barrels, marking the first upturn in production since 1978 (19).

- As crude oil imports have declined, the sources of these imports have undergone a significant change. In 1977, the peak import year, 70 percent of total imports were from OPEC nations, with 42 percent from Arab nations and Iran (20). (Nearly 90 percent of OPEC imports are crude oil.) In 1982, only 48 percent was imported from OPEC, and only 18 percent from Arab nations and Iran (21). Sources are more diversified in the early to mid-1980's, but in particular both Mexico and the United Kingdom have become very important crude oil suppliers. Together they provide nearly a quarter of U.S. total imports (most of that being crude oil), while in 1977 they supplied only 3 percent (22).

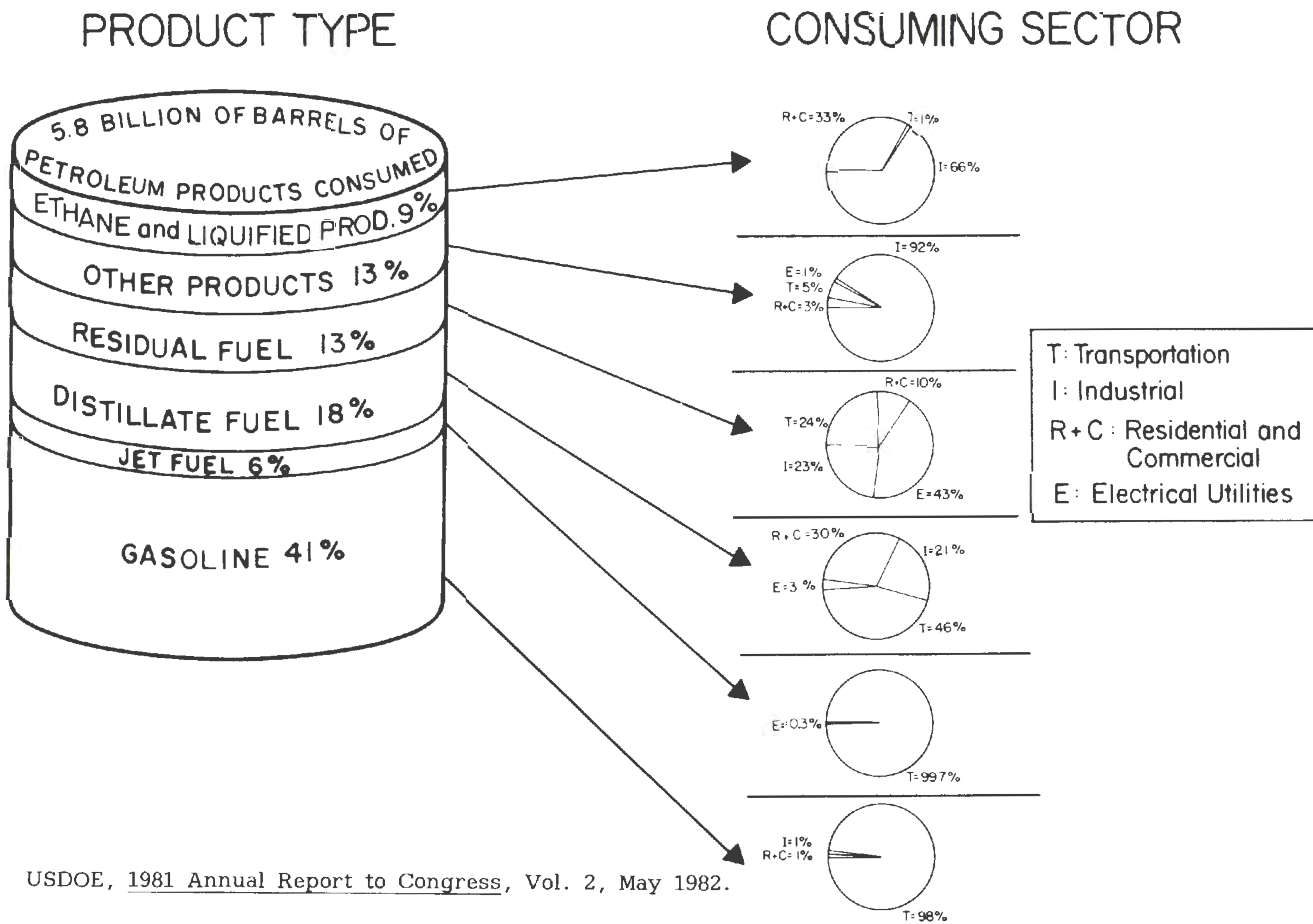
Nearly half of all U.S. refining occurs in the southwestern U.S. (primarily Texas and Louisiana), while only about 10 percent occurs in Atlantic Coast states, which comprise the major consuming market (23). As a result, almost half of what southwestern U.S. refineries produce is shipped to the Atlantic Coast by pipeline, tankers and barges (24). This is only an extreme example, however, of the significant amount of interregional movements of petroleum products which occur in the U.S. In fact, even the Atlantic Coast states export products to southwestern states (admittedly though, not a great deal). To a large degree, these patterns, which are shown in Table 2.1, represent the complex logistical system existing among oil refiners, distributors and customers.




Source: USDOE, Petroleum Supply Annual: 1982, Volume 1, June 1983.

FIGURE 2.2

REGIONAL OIL CONSUMPTION IN THE U.S.: 1982




Source: USDOE, 1981 Annual Report to Congress, Vol. 2, May 1982.

FIGURE 2.3

U.S. OIL CONSUMPTION BY PRODUCT AND INDUSTRIAL SECTOR: 1981

TABLE 2.1

INTER-REGIONAL[1] SHIPMENTS OF PETROLEUM

PRODUCTS IN THE U.S. - 1982

| Millions of Barrels Shipped From: | Millions of Barrels Shipped To: Atlantic Coast | North Central | South-West | Rocky Mountains | Pacific Coast |
|---|---|---|---|---|---|
| Atlantic Coast | - | 95 | 7 | 0 | .2 |
| North Central | 34 | - | 66 | 29 | 0 |
| Southwest | 1013 | 271 | - | 0 | 29 |
| Rocky Mtns. | 0 | 13 | 5 | - | 13 |
| Pacific Coast | 2 | 0 | 3 | 0 | - |

1. For definition of regions, see Figure 2.2

Source: U.S. DOE, Petroleum Supply Annual: 1982, Vol. 1, June 1983.

### 2.3.2 Distillate Product Overview.

As Figure 2.3 indicates, distillate fuel products are the second largest set of oil products consumed in the U.S. and are consumed in substantial amounts by each of four industrial sectors. (Only in electricity generation are distillate products scarely used.) In 1982, just under one billion barrels of distillate fuel products were consumed (25). Two products dominate distillate product consumption: heating oil and diesel fuel. In fact, most of the heating oil and diesel fuel consumed in the U.S. are nearly identical by composition, but do differ in their distillation fraction.

Distillate product use grew along with overall oil use throughout the 1960's and 1970's, while more recently there has been a decline in its use. Current consumption at the end of 1982 was 22 percent below the 1978 level, which was the peak oil use year (26). But the decline basically reflects the tremendous amount of conservation and fuel switching that has occurred among heating oil users, primarily in the residential sector. So-called heating uses of distillate products consumed 39 percent less fuel in 1982 than they did in 1978 (27). On the other hand, diesel fuel use by railroads and marine vessels declined only slightly during this period, while on-highway use of diesel fuel grew by 16 percent (28). Between 1978 and 1982, diesel fuel grew from about 46 percent to 59 percent of total distillate fuel product consumption (29).

The 1980-84 status of distillate fuel products consumption in the U.S. is characterized as follows:

- About 75 percent of heating oil used for residential purposes occurs among Atlantic Coast states (30). On the other hand, on-highway diesel fuel consumption is spread out more evenly: Atlantic Coast--29 percent; North Central--35 percent; Southwest--18 percent; Rocky Mountain--4 percent; and Pacific Coast--14 percent (31).

- Among on-highway diesel fuel consumers, heavy trucks use 92 percent of the supplies (32). Urban transit is the next largest user at 3 percent, followed by light trucks and automobiles at 2 percent each, and intercity buses with only 1 percent (33).

- Railroads and marine vessels are the other transportation modes utilizing diesel fuel, although together they consume less than half of the amount heavy duty trucks consume annually (34). The other major consumers of diesel fuel are agricultural and construction machinery.

The 1980-84 status of distillate fuel products supply in the U.S. is characterized as follows:

- Only three percent of distillate fuel products consumed in the U.S. in 1982 was imported (35). Most of that originated from Carribean refineries (36).

- The nation's major oil companies refine around three-fourths of the nation's distillate fuel (37). This is only slightly less than the share of gasoline which they produce, and represents an increased market share in distillate fuel production since the late 1970's (38).

Historically, a substantial portion of distillate products have been distributed at the wholesale and retail level not by the nation's major oil companies but by middlemen firms known as jobbers. Jobbers supply the residential sector with 85 percent of its heating oil needs. They also supply a substantial portion of diesel fuel through bulk sales to large users and smaller scale sales to truck stops (39). Heating oil distributers have by and large been local, relatively small, firms (often family run), while diesel fuel distributors are likely to be bigger (some operating large terminal operations) and often market gasoline products as well. In the past few years however, major oil companies have increased their penetration into direct marketing of distillate products (40). In particular, this include large scale diesel fuel supply agreements with public transportation systems.

## CHAPTER 3

## EXAMINING THE WORKINGS OF ONE OIL MARKET: TRANSIT SYSTEMS AND DIESEL FUEL

### 3.1 Introduction

Despite the conditions described in Chapter 2, uncertainty over supply and price trends still motivates a considerable number of oil consumers. This is particularly true for most transit systems in their dealings to obtain diesel fuel.

This chapter explores why that uncertainty exists and how it affects business relationships in the transit diesel fuel market. The chapter is divided into two main sections. The first briefly summarizes diesel fuel demand by transit systems. The second section is a microscopic analysis of key institutions which bring diesel fuel suppliers and transit systems together.

In the second section, through a discussion of contractual arrangements, the spot market, the futures market and inventory policies, the effects of uncertainty are revealed. Much of this analysis is based on detailed personal interviews with fuel procurement officials of six of the nation's transit systems: The New Jersey Transit Corporation (NJTC), the Southeast Pennsylvania Transportation Authority (SEPTA), the Washington Metropolitan Area Transportation Authority (WMATA), the Chicago Transit Authority (CTA), the Regional Transportation Authority (RTA) in the Chicago suburbs and the Houston Metropolitan Transportation Authority (MTA) (1). Additional and less detailed interviews were held with fuel procurement officials of the Southern California Rapid Transit District (SCRTD) and the Municipality of Metropolitan Seattle (METRO) (2). Finally, two recent studies summarized certain fuel procurement activities of many of the nation's transit systems (3). Other sources were used as well and referenced throughout.

### 3.2 Transit Diesel Fuel Demand

Data collected by the Urban Mass Transportation Administration on the largest 300 transit systems in the U.S. show that they consume nearly 10 million barrels of diesel fuel annually (4). That represents 98 percent of bus transit energy consumption; gasoline and propane made up the remaining 2 percent (5). Table 3.1 shows that consumption is naturally skewed toward the larger systems, of which there are relatively few.

The most commonly used form of diesel fuel is diesel fuel #2, which is used by nearly all diesel powered trucks. Transit systems, however, have historically used a higher quality fuel, known as diesel fuel #1. Its principal benefits are that a) it allows better starting ability in cold, wet weather conditions, b) its properties are better suited for engines requiring frequent load and speed changes, and c) it emits a lower level of air pollutants, especially visible smoke emissions (6). In discussions with refiners, it was noted that the oil industry no longer actually produces diesel fuel #1, simply

TABLE 3.1

PUBLIC TRANSPORTATION DIESEL FUEL CONSUMPTION

| | # BUSES IN SYSTEM: | | | TOTAL SYSTEMS |
|---|---|---|---|---|
| | 1-99 | 100-500 | 500+ | REPORTING |
| # of Systems | 219 | 57 | 25 | 299 |
| Diesel Fuel Consumed Per System (Barrels) | | | | |
| - Annual | 5,784 | 41,734 | 244,667 | 9,742,857 |
| - Monthly | 482 | 3,453 | 20,389 | 811,904 |
| - Daily | 16 | 114 | 670 | 26,693 |

Source: UMTA, National Urban Mass Transportation Statistics: 1981 Section 15 Report, Washington, D.C., November 1982.

because the demand for it is so limited. Rather two products which are similar to the properties of diesel fuel #1, kerosene and jet fuel, are treated with some minimal after-processing or blending to produce a fuel comparable to transit fuel requirements (7).

However, even the transit market for diesel fuel #1 is dwindling, as a growing number of systems are switching over partially or completely to diesel fuel #2. Cost savings is the key reason: #1 generally costs approximately $.05 more per gallon, essentially because kerosene and jet fuel are better refined products. Detroit Diesel Allison, the manufacturer of engines for GMC buses in the early 1980's specifies diesel fuel #2 as an acceptable fuel for its engines (8). Maintenance and starting ability are no longer severe problems as the quality control on diesel fuel #2 has improved over the years (9). Already such systems as the Washington Metropolitan Area Transit Authority, Chicago Transit Authority and Southeast Pennsylvania Transportation Authority have switched partially or entirely to diesel fuel #2.* APTA recommends continuation of the trend as cost- and energy-saving steps (10).

### 3.3 Transit Systems and Diesel Fuel Suppliers: How They Interact

Four basic practices are of interest in covering the major interactions between all oil consumers and suppliers. These are the following:

1. Long-term contractual agreements for fuel supply.

2. Short-term spot market agreements for fuel supply.

3. Hedging against uncertain fuel price and supply conditions in the commodity futures market.

4. Maintaining fuel inventory for normal or emergency purposes.

All of these practices have been affected by deregulation: a) in a direct manner by the actual removal of price and allocation controls, and b) indirectly by the change in oil production and consumption patterns which deregulation has helped to create. Although deregulation and its aftermath has set the stage for basic changes in these practices, there has been exhibited some resistance to change. Transit properties, on the whole, are among those which have not instituted much change in the way they typically purchase and store their fuel. It is useful to examine what has changed and what has not, and how this relates to the overall concept of uncertainty.

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* Partial switching has meant use of a) #1 in winter only, b) a #1/#2 blend, or c) use of #1 in limited geographic areas, so as to avoid higher smoke emissions in residential neighborhoods.

### 3.3.1 Long-Term Contracts

Virtually all oil product suppliers and consumers are linked by contractual supply agreements. The one major exception is the automobile owner, who generally has no formal purchase agreement with a service station (outside of credit allowances). Contracts specify many items, including product specification and manner of delivery. These are usually spelled out in considerable detail. However, the two most notable items covered by the contract, the price and quantity to be supplied, are generally listed in more flexible terms. A base price is normally agreed upon, but so is a basis for varying that price to account for constant fluctuations in the price of oil and oil products. This so-called "posted price" provision pegs the delivery price to some recognized cost index, generally published in newspapers or trade journals (e.g., Platt's Oilgram). The quantity to be supplied is also generally an estimate. Obviously this flexibility exists so as not to penalize buyers for overestimates or underestimates made when the contract was drawn up. But is also allows the buyer to respond to favorable or unfavorable price changes associated with the contract. Thus, buyers could purchase more or less of their estimated fuel requirements within contractually specified limits. As an example, in its most recent fuel contract with Mobil, the Houston Metropolitan Transportation Authority (MTA) specifies 6 million gallons as its annual diesel fuel requirement. But the contract would still be in effect if the MTA purchased as few as 3 million gallons from Mobil and bought the rest from a potentially cheaper source.

The Federal regulations in effect prior to early 1981 did not restrict these flexible price and supply provisions. But on the other hand, deregulation (as well as the accompanying oil glut) has enhanced their flexibility. During the 1970s, posted price provisions were generally written as escalation clauses: they adjusted contract prices to reflect upward changes in oil prices. Any downward changes were not considered (few actually occurring during this period). With early to mid-1980's supply and price market conditions, sellers offer and buyers demand de-escalation clauses as well. There is also more flexibility in the choice of the posted price index and how often that index is consulted. Essentially, suppliers are more willing to deal. Thus, one system (Chicago Transit Authority) has had a contract specifying an index reflecting local area diesel fuel prices charged for tankcar or truck transport. The index is posted on a weekly basis, so that prices remain firm for seven days. The Houston MTA has a more favorable index: the price charged to large scale diesel fuel distributors by a major refiner. However, that index can vary on a daily basis.

There are other options available as well, but they are not widely utilized, especially by transit systems. One such option is fixed-price, fixed-quantity contracts (e.g., no price adjustments, no partial deliveries). These are becoming somewhat more common in the oil industry (11). The major benefits are a) for the buyer, it introduces true price certainty, allowing accurate budget planning, and b) for the seller, it guarantees disposal of a fixed amount of fuel. For government agencies, budget stabilization is important; for transit properties in particular it is crucial. As a result, in 1981 the Washington Metropolitan Area Transit Authority (WMATA) undertook a fixed-price contract approach. The contract established fixed quarterly prices and the total fuel expenditure was known prior to the new fiscal year. Unfortunately, oil prices began to drop soon after the contract took effect, to the point where

WMATA calculated that it had foregone a savings of around $300,000 by not utilizing a normal escalating/de-escalating posted price contract. However, for its 1982 contract, WMATA secured the best of both worlds: it negotiated a contract having a fixed-price ceiling along with a posted price index when prices dropped below that ceiling. In this case, the transit property had a known fuel budget with the possibility of a year-end surplus (but no surprise deficits).

Another option is a shorter term contract, allowing the buyer to adjust more rapidly to favorable or unfavorable changes in oil prices, as well as allowing a wider number of sellers to bid for the contract (many of these able to offer cheaper prices because they themselves obtain their supplies via short-term agreements or from the spot market). During regulation, short-term contracts were an anathema, leaving buyers vulnerable in the event of allocated shortages. Under deregulation and an oversupplied market, they are an attractive means of lowering fuel costs. One transit property which has adopted short-term contracts is the Regional Transportation Authority (RTA) which purchases diesel fuel for 12 suburban bus companies and 4 commuter rail lines in the Chicago area. Its contracts last for one month, during which time the seller specifies a fixed ceiling price which may not be exceeded, but which can be undercut by request of the RTA.

A third option, alluded to earlier, is for the buyer to maintain normal long-term, posted price contracts, but simply request less fuel than estimated while purchasing the balance from other, cheaper sources. Houston MTA's contract requiring the buyer to purchase only 50 percent of estimated contracted fuel needs is typical of the transit and oil industry. Less typical is the RTA contract, already geared toward taking advantage of short-term price changes by its one month length. RTA has the option on a week-to-week basis to seek out lower priced fuel and, after giving its contracted supplier the right of first refusal, to purchase all its required needs from noncontracted sources. It has not been that unusual in the course of a given month for RTA to request no fuel from its contract source.

However, except for the notable cases presented here, few other transit systems are pursuing these types of cost-saving or budget stabilizing changes related to contractual fuel agreements. Many transit fuel supply contracts still do not include price de-escalation clauses (12). Fixed-price contracts are rarely pursued: even WMATA no longer utilizes one. Most systems have not switched from annual to shorter term contracts and most have not sought out lower priced fuel sources during the course of a contract. Essentially, most transit systems are maintaining good, longstanding and traditional relationships with regular diesel fuel suppliers.

Why are transit systems foregoing cost-savings in favor of maintaining pre-deregulation relationships? One reason has to do with the level of sophistication among transit fuel procurement offices. In the past, a great deal of effort has been expended by these offices toward insuring that a high quality fuel product was being consistently delivered. (Until the early 1980's, the quality control on diesel fuel products was uneven at best.) Financial considerations took a back seat. Indeed this was probably appropriate. Prior to the 1970s, regulatory controls restricted the financial options which a transit system was able to make. Added to this is the overall poor financial status of transit systems, many having difficulty paying past bills, let alone pursuing innovative contractual arrangements.

Another reason for foregoing new contractual practices is that not all transit systems have the leverage available of an RTA, WMATA or Houston MTA. These systems purchase relatively large amounts of fuel and furthermore are located in urban areas and in regions where there are a large number of diesel fuel sellers. In smaller, isolated areas, it is more difficult for transit properties to establish a buyer's market advantage. Add to that the poor reputation transit systems generally have in terms of paying bills on time and it becomes clear why more flexible price options may be difficult to obtain.*

But perhaps the strongest reason is that transit systems, faced with the loss of the supply certainty afforded them by Special Rule No. 9, see the longstanding traditional fuel contract as an important means of restoring some measure of certainty. First of all, by maintaining long-term, high-volume contracts, transit systems expect greater responsiveness on the part of the supplier to problems which might arise, be they related to supply, payment schedules, product quality, etc. Secondly, as a contingency measure, transit systems want to maintain a long-term, high-volume relationship with a supplier, with the expectation that government- or supplier-imposed allocation procedures will be reinstated during a disruption. These measures, which are intended to reduce uncertainty through better supplier relationships, have one particular imperfection. They have not yet been tested under the strain of an oil disruption within a free-market setting.

It is interesting to note that this view of long-term contracts is not only confined to transit systems. Trucking firms, many of which experienced supply problems during past disruptions, favor this option. Ryder, for instance has considered three-year contracts with major oil companies (13).

### 3.3.2 Spot Market

Spot markets primarily exist around major oil refining centers: the U.S. Gulf Coast, Rotterdam, the Caribbean, Singapore, etc. But any oil port or pipeline is likely to generate some spot market behavior. The volume of petroleum products bought on a spot market basis is relatively small worldwide, estimated to be between 5 and 15 percent of total deliveries at any one time (14). Spot market purchases are one-shot deals, e.g., a tanker-filled with surplus diesel fuel. Prices vary on a day-to-day basis, and often minute-to-minute. Essentially, spot market transactions serve as a supply balancing mechanism for refiners and markets (and to a lesser extent, consumers).

During disruptions, the movement of prices on spot markets is always in one direction -- up. Refiners, marketers and consumers all come to the spot market to fill out their shortages and prices react accordingly. But during periods of oversupply, the spot market absorbs large surpluses and product prices drop. As a result, since mid-1981, bargains abound in spot markets around the world.

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* Even large systems often have leverage problems. The Southern California Rapid Transit District, the nation's largest all-bus transit system (over 2400 buses) has been unable in the recent past to attract any bids on a price-fixed supply contract.

Spot market purchases in the U.S. are often handled through brokers and importers. Jobbers and other distributors are generally the next link in the supply chain, but consumers do often bypass them and enter directly into spot market purchases. During the 1979 Iranian crisis, the Ryder Truck Rental firm entered the spot market to ensure adequate diesel fuel supplies for its vehicles (15). Currently, a number of private railroad companies buy diesel fuel on the spot market at a considerable savings over contractual agreements (16).

Transit systems, unlike private trucking and railroad firms, cannot simply go out to the spot market and purchase their fuel requirements. Since most are government agencies, they are bound by the rules of government purchases: soliciting bids and evaluating the adequacy of responses. While securing the lowest priced purchases is nearly always the goal of these rules, other goals (e.g., minority business promotion, proving financial health, buy America, etc.) as well as the need for an adequate review period make the type of sudden surplus purchases available on the spot market a highly doubtful possibility for transit systems. The possibility can, however, be enhanced by instituting short-term contracts (e.g., one month in length) or by deferring delivery of contracted supplies. In the first case, short-term contracts make it likelier that brokers or distributors who deal in the spot market may enter a bid, guessing that spot prices will remain constant for the brief length of the contract. In the second case, having followed purchasing rules in obtaining the current contract, cheaper products can be obtained from non-contracted sources without the need of another bid solicitation.

But, as already shown, most transit systems are not opting for short-term contracts or refusal of contracted deliveries. Even if they were, however, transit systems are pursuing one major action which would almost certainly eliminate spot market sources. Transit systems keep a close review over their diesel fuel suppliers. Review begins at the time of fuel contract solicitation, with an inquiry as to the source of supplies of all bidders and an informal survey among area diesel consumers to check the supply reliability of new bidders. (Fuel quality issues may also be checked.) Although it is not normally a contract requirement that fuel supplies emanate either from domestic sources or a major oil company, transit systems do at least attempt to define the supply chain and evaluate its reliability prior to awarding of contracts.

The reason for the review is to reduce supply uncertainty. Firmly established supply chains are heralded as an important way in which to insure against fuel cutoffs during oil disruptions (17). Obviously, direct or indirect spot market purchases clash with this concept of reducing supply uncertainty, and it is primarily for that reason why transit systems generally avoid the spot market.

### 3.3.3 Commodity Futures Market

Uncertainty creates commodity markets and futures contracts. When there is uncertainty about price and supply, there are suppliers and consumers who desire to hedge against future misfortune.* And there are speculators willing

* Weather also is an uncertain and key factor. A harsh or mild winter will affect heating oil demand and consequently affect price.

to accept the risks and reap the benefits of the uncertain future. As a result, futures contracts for about 50 different commodities are formally traded in North American Exchanges (primarily in Chicago and New York). Included among these are various energy commodities: heating oil #2 (roughly equivalent to diesel fuel #2), gasoline and, most recently, crude oil.

Heating oil futures are of concern in this case. Trading began on this product in late 1978 (at the New York Mercantile Exchange), but did not attract significant interest until the 1980s. The joint onset of deregulation and the worldwide oil glut greatly increased price uncertainty, since price controls were eliminated and the price-setting power of OPEC members decreased. By November 1982, over 135,000 contracts for heating oil were being traded every month at the New York Mercantile Exchange (twice as much as the year before), representing 135 million barrels of heating oil (18). However, futures contracts are almost never carried out to their logical end: product delivery occurs in only three to seven percent of all contracts (19). Instead, contracts are generally sold back to the original seller.

The heating oil futures market is utilized by refiners, jobbers, large-scale consumers and speculators. Refiners and jobbers generally enter the market to protect themselves against market price reductions before they can sell existing supplies. On the other hand, consumers normally assume positions in the futures market that allow them to protect themselves against price increases. Speculators are not hedging at all but simply trying to profit from price changes. As a result of these goals, refiners and jobbers generally sell futures contracts, which are fixed-price agreements to deliver a fixed quantity and quality of heating oil at a pre-specified location in a given future month. The price is set by the seller at a level higher than that which future market prices are expected to be. Consumers buy futures contracts, agreeing to a price below that which they expect future market prices to be. Speculators buy and sell regularly in order to benefit from whatever price changes are likely to occur.

If prices do indeed drop, the seller has the benefit of owning a contract for delivery at a higher than market price. Sale and delivery can actually be performed, or, more likely, the seller will buy back the contract at a negotiated price. That negotiated price may be less than the futures contract price, but will always be more than the current market price. The seller will then offer that supply on the spot market or as part of its normally contracted supplies at the market price. The difference between the current market price and the amount that the seller has earned by repurchasing its futures contract is the price protection earned through the futures market.

On the other hand, the consumer will lose out on the benefits of market price decreases if it has purchased a higher price futures contract in expectation of increasing prices. However, since the buyer was willing to pay that price when originally purchasing the futures contract, it has not so much suffered a monetary loss as much as foregone a possible savings.

If, however, market prices increase, the consumer has the protection of the lower priced futures contract, which when sold back to the seller should provide enough profit to pay the current market prices. At the same time, sellers will be unable to benefit from market price increases because of the loss involved in buying back lower priced futures contracts.

To summarize, hedging is a defensive act, intended to protect the seller's margin or the buyer's budget at the cost of maximizing the seller's profits or minimizing the buyer's costs.

Why should diesel fuel users be concerned with heating oil futures? As discussed earlier, the two products are very similar. Under extreme circumstances, diesel fuel consumers could take delivery on heating oil futures contracts, although post-delivery additives would probably be required. There are, however, enough other disadvantages to taking delivery that normally this would be a poor alternative. (See, however, the discussion in Chapter 6 on the use of the futures contracts as a contingency supply measure.) The more important reason is that the market prices of heating oil and diesel fuel are closely related. In 1982, for example, month to month wholesale price changes in diesel fuel and heating oil moved in the same direction in all but two instances, and often by nearly the same magnitude (20). Therefore, consumers can hedge, with relative assurity, against diesel fuel price increases by using heating oil futures contracts.*

In practice however, not many diesel fuel users have entered the futures market. Freight carriers, including truckers, railroads and barges, are reported as not participating in the market and being unfamiliar with trading practices (21). Ryder is an exception, indicating some interest in pursuing futures contracts (22).

Among transit systems, only a few have entered the market, in particular the Southern California Rapid Transit District (SCRTD). Since early 1982, SCRTD has hedged about two-thirds of diesel fuel needs as a means of stabilizing its fuel budget. As a result, it has not only been able to protect itself against every diesel fuel price increase, but save $250,000 in fuel costs.

WMATA was indirectly involved in the futures market at one time. During a period when it used price-fixed contracts, its supplier was able to meet its price through constant buy and sell activity in the futures market.

Why is participation among diesel fuel users in general and transit systems in particular so low? There are technical reasons. The individual futures contract involves delivery of 1,000 barrels of heating oil in a given month. As Table 3.1 indicates, of the 299 systems reporting Section 15 data in 1981, less than 100 transit systems had monthly consumption in excess of this amount. Most systems are simply too small to participate independently in the futures market. Furthermore, diesel fuel price changes at a given location over a given time period do not always match the changes occurring in the futures market. This variance not only complicates hedging but may make it unprofitable. SCRTD, for example, drops out of the futures market whenever the spot price for delivery of diesel fuel in the Los Angeles area consistently reaches a certain differential from the New York futures market price.

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* Diesel fuel suppliers can similarly hedge against price decreases by entering the heating oil futures market.

There are institutional reasons also. Transit authorities, as government agencies, may need special legislative permission to enter the futures market. SCRTD received such authority, but only after mollifying legislators' concerns about about investment risks and the possibility of taking delivery on a contract. Furthermore, certain typical fuel supply contract provisions can introduce added risk into the buyer's hedge. If there is no price deescalation clause, for example, in the fuel supply contract, market price reductions will not be passed on to the consumer. But at the same time, the consumer will be stuck with higher priced futures contracts, with no surplus available to buy out of the contracts. Also, depending upon what posted-price index is used in the normal supply contract, there could be a significant difference between local and futures market prices.

A more basic reason, however, is that many diesel fuel users, (most notably transit systems, but also trucking firms and railroads) have had little experience and little incentive to engage in fuel price protection. Until recently, truckers and railroads were heavily regulated, such that price competition was rare and cost increases were eventually filtered through as rate increases. Only in the deregulated environment of the 1980's is price competition a reality. Transit systems, as has been previously discussed, have not paid much attention historically to financial considerations of fuel purchasing. To the extent that such considerations have taken hold, they have resulted in changes to the actual fuel supply contract itself. There is a pervasive lack of understanding and wariness among most transit systems concerning extra-contractual arrangements such as the futures market. The incentives to explore price protection are far outweighed by the perceived cost and risks of the futures market.

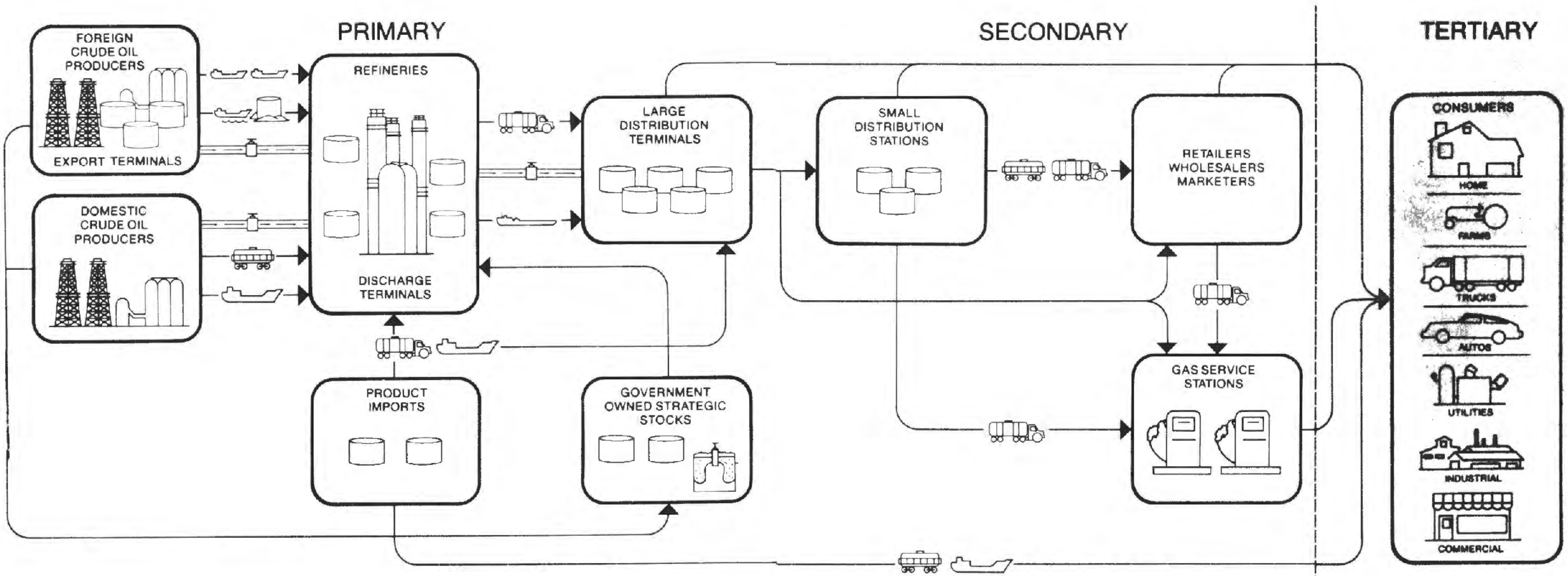
### 3.3.4 Inventory

Oil inventories are maintained throughout the oil supply-consumption chain, as Figure 3.1 shows. Only primary sector inventory levels are known, averaging 1.4 billion barrels in the U.S. in mid-1982 (23). An alternative way to view this 1.4 million barrels of stock is as the equivalent of nearly 90 days of current consumption. Some experts estimate that secondary and tertiary inventories together could equal or exceed the primary sector total, but there are no true measurements: a monthly monitoring of tertiary inventories, for example, would require the effort equivalent to a monthly national population census (24). Throughout all sectors, however, there is some minimum operating level of inventory, supplemented by a fluctuating, usable level of additional stocks.

The minimum operating level of stocks held by the primary sector represents about two-thirds of their total inventory (25). The remainder includes contingency storage (including the U.S. Strategic Petroleum Reserve) as well as stocks laid in to provide

> "flexibility to meet seasonal and day-to-day changes in demand, to accomodate altered tanker schedules and to withstand the impact of bad weather on port operations (11)."

Although no macroscopic data is available, it would appear that, in general, a much greater percentage of inventories held by secondary and tertiary sectors represents minimum operating levels, and that the percentage




Source: Exxon, Inc., World Oil Inventories, August 1981, pp. 4-5.

FIGURE 3.1

THE OIL SUPPLY-CONSUMPTION CHAIN AND ITS POINTS OF INVENTORY STORAGE has grown during the early 1980's. For example, heating fuel distributors and jobbers used to lay in large stocks during the summer in preparation for winter sales. They were aided in this action by liberal purchase agreements with major refineries (generally known as the summer fill program), which deferred payment for the built-up inventory until autumn. Refiners have for the most part ended the summer fill program and at the beginning of each of the winters in the early to mid-1980's, most distributors and jobbers had stock levels below what used to be called normal (27). Among other fuel product distributors and large-scale consumers, inventories were reduced beginning in 1981 due to high interest rates, declining fuel prices and plentiful supply.

This trend toward lower inventories, beginning in 1981, clashed with the trend begun in 1980 to increase storage facilities and supplies for contingency purposes. It is believed that high inventory levels among all sectors in late 1980 were responsible for avoiding a price and supply crisis when the Iraq-Iran War caused a seven percent drop in world oil production (28). One small-scale heating oil/diesel fuel jobber, always wary of supply contingencies, constructed a major storage facility as early as 1950 (29). Among consumers all types of freight carriers have increased their fuel storage capacity since 1980 -- from days to weeks for some, from weeks to months for others (30). Some transit properties have done likewise, generally constructing larger fuel storage tanks at new garage facilities and in some instances expanding existing storage facilities (e.g., WMATA).

Among 100 transit systems responding to a survey in early 1982, 30 percent had some diesel fuel reserve storage and another 20 percent were planning to acquire a reserve (31). Among the most ambitious was the Seattle METRO system, which first began to lease extra storage capacity in 1979 and in 1982 purchased a former tank farm and began converting it into a diesel fuel storage facility. It is intended for the facility to hold 90 days worth of supply.

In practice, the storage contingency plans of most consumers have not survived the economic influences toward reduced inventory. As of 1984, the jobber discussed above has not maintained full storage facility since 1980. In contrast to expansion of storage capacity among freight carriers, many have reduced actual levels held, including one instance where the nation's sixth largest trucking company drained a 200,000 gallon fuel tank at its main terminal in order to reduce inventory costs (32).

Many transit systems continue to operate with minimum inventories: large bus systems in Chicago, Philadelphia and New Jersey require daily deliveries. Others, including RTA in Chicago and WMATA, have deferred purchasing additional storage capacity because of the changed economic picture. Even Seattle METRO has considered alternative uses for its storage facility as of 1983-84, including using it as a daily operations fuel distribution center.

In summary, fuel supply uncertainty in 1979-80 sparked considerable interest among transit systems to expand inventory levels in order to meet contingency situations. Deregulation only increased that uncertainty but since then, the threat of supply problems has been perceived to have disappeared, while the economic conditions of high interest rates and steady or declining diesel fuel prices have caused high inventory levels to be viewed more as a liability than as a safeguard. Inventory levels in 1980-84 are as close to the minimum operating levels as they have been in a number of years.

### 3.4 Summary

Transit systems are not anxious to alter significantly the relationships they maintained with their diesel fuel suppliers in the 1970s. To some extent this is common sense in action: for example, those who live with the spot market (i.e., turn from higher priced, long term contracts to cheaper, short term sources), die with the spot market (i.e., during supply contingencies, spot market prices rise early and high). To some extent this is the result of fuel purchasing policies less concerned with financial issues (e.g., what the futures market offers) than with fuel quality issues. Nonetheless, transit systems are responding to their uncertainty over losing priority supply status given a future oil disruption by maintaining good customer status with reliable domestic fuel suppliers.

While supply uncertainty is the most important factor in understanding why transit systems have tended toward status quo fuel supply arrangements, it provides no explanation as to why so few systems maintain contingency fuel supplies. Here, it is evident that economic factors (i.e., high interest rates, declining fuel prices) have reduced the incentives for high inventory levels. But transit systems are not alone in this regard: other diesel fuel consumers as well as distributors and even refiners in 1983-84 were maintaining their lowest inventory levels in years.

# CHAPTER 4

# U.S. OIL MARKETS DURING SUPPLY DISRUPTIONS

## 4.1 Introduction

This chapter summarizes the history and effects of the oil supply disruptions which occurred during the 1970s. It then draws upon this information to forecast the characteristics and effects of future oil disruptions. Essentially, there is considerable uncertainty concerning future disruptions, which can be summed up as four basic questions.

1. What will disruptions be like -- their size, duration, etc.?
2. What will happen to the supply of petroleum products?
3. What will happen to the price of petroleum products?
4. What role is government likely to take during the disruption?

These questions are answered in the remaining sections of this chapter. The answers are based on information gathered from a) interviews with key officials of major and small oil supply companies (1), b) interviews with oil industry association representatives and energy-related government officials (2) and c) existing literature sources.

## 4.2 What Will Disruptions Be Like?

### 4.2.1 Experience of Prior Disruptions

Table 4.1 summarizes the basic characteristics of the three oil supply disruptions of the 1970s. The first, in 1973, was the result of sudden OPEC production quotas. (Although an embargo was also placed on the U.S. and Holland by OPEC nations, that action was fully circumvented through third party sales.) Five years then passed until the Iranian Revolution brought on the episodic 1978-79 disruption. As of 1983, the most recent oil disruption which the world has faced occurred in late 1980 as a result of the Iran-Iraq War.

Judging by the amount and duration of oil production, none of these disruptions could be classified as overly severe. However, the effects of the disruptions often were severe. The history of these disruptions suggests that the severity of impacts had more to do with factors unrelated to the actual duration and amount of production cutback. The suddenness of disruptions was a key factor. The 1973 cutbacks were certainly sudden. They were a completely new economic weapon in oil markets and they were put in place quickly. In contrast, the large cutbacks occurring in Iran at the end of 1978 happened in a slower, erratic fashion, and were consequently less detrimental.

A second factor was the uncertainty about how long and how intense a disruption would be. Even when world production cutbacks were not severe, some oil companies were stockpiling in anticipation of more severe shortages (3).

TABLE 4.1

CHARACTERISTICS OF THE THREE OIL SUPPLY DISRUPTIONS OF THE 1970s

| Disruption | Began | Duration | Free World Oil Production Reduction: Millions Barrels/day | % |
|---|---|---|---|---|
| 1. OPEC cutbacks | 10/73 | 4 months | 4.6 | 9.6 |
| 2. Iranian Revolution | | | | |
| a. Initial Iran losses | 10/78 | 2 months | 4.0 | 6.4 |
| b. Saudi cutback I | 1/79 | 2 months | 0.5 | 2.5 |
| c. Saudi cutback II | 5/79 | 1 month | 0.1 | 0.2 |
| d. U.S. embargo | 11/79 | 2 months | 0.7 | 1.1 |
| 3. Iran-Iraq War | 9/80 | 2 months | 3.6 | 6.1 |

Source: Philip Verleger, Jr., Oil Markets in Turmoil: An Economic Analysis, Ballinger, Cambridge, 1982, pp. 31-38.

A third factor is the level of inventory stocks prior to a disruption. When inventories are relatively low, disruptions lead refiners, distributors and consumers a) to venture into the spot-market for available supplies and b) to stockpile their supplies to protect themselves against higher prices and new shortages. (Even such small scale consumers as auto owners topped off their tanks when disruptions began.) These actions in turn reduce the supplies available for consumption and further drive up spot market prices. For example, in September 1980, inventories were particularly high and new stockpiling did not occur; spot market price increases were moderate; nor were other impacts severe.

A fourth factor is the type of action government may take in the face of a disruption. Price and allocation controls as well as voluntary and incentive measures, can have unforeseen effects.

In summarizing the experience of past disruptions, one need only briefly review the 1978-1979 crisis from the perspective of these four factors. In late 1978, some 4 million barrels per day of world oil production was slowly taken off-line. Worldwide inventories were generally high, however, and as a result little panic buying occurred: spot market prices in Rotterdam rose only 13 percent in one month and declined the following month (4). In late January of 1979, as Iranian production was returning, Saudi Arabia suddenly removed a relatively small amount of oil from world production: 0.5 million barrels per day. Due to the earlier cutoff, inventories were lower. Also although the Saudi reduction lasted only a month, it was initially announced that the cut would last longer and be of greater size (5). There was further uncertainty about what the Saudis and other OPEC members would do later in the year. As a result, considerable stockpiling occurred and use of the spot market intensified; spot prices consequently jumped 65 percent in one month (6).

U.S. oil companies, however, were asked by the U.S. government to avoid the spot market and at the same time to further stockpile supplies, concentrating on heating oil. Soon spot shortages of diesel fuel appeared. In May of 1979, USDOE tried to relieve these shortages by reversing its earlier position and encouraging spot market entry. Coincidentally, the Saudis clouded the supply situation again by altering contractual sale agreements (although actually removing only 0.1 million barrels per day from production for a month). Together, these actions again intensified spot market activity, causing price increases and greater stockpiling. Gasoline station lines in May through early July of 1979 in many parts of the U.S. were worse than in 1973—this despite the fact that a significantly smaller supply disruption occurred.

By early fall 1979, the OPEC supply situation had settled and inventories were again high due to stockpiling and a price-induced reduction in demand. In November, the U.S. embargoed all Iranian oil (because of the hostage situation) and threatened sanctions against nations which offered to buy these supplies instead. Consequently, some Iranian production was cut back (0.7 million barrels per day), but a good deal more went to the spot market where it was sold less visibly (7). Although spot market activity intensified somewhat, the added supplies in the spot market arena, combined with relatively high worldwide inventories, kept price increases down and avoided detrimental impacts.

In conclusion, past disruptions suggest that such factors as 1) suddeness of supply change, 2) uncertainty over the length and intensity of that change, 3) the level of predisruption inventories and 4) the response of government were of greater influence in causing the effects on oil markets than were the actual size and duration of those disruptions.

4.2.2 Predictions of Future Disruptions

"Another oil disruption is not only possible, but quite likely," states the U.S. Congressional Budget Office (8). To prepare for that likelihood, it and many other organizations have prepared scenarios of what future disruptions might entail. In terms of previous disruptions, most are longer term and generally of greater magnitude in terms of production loss. The scenarios can be classified as follows.

1. Minor Disruptions - These generally involve no more than a 7-8 percent loss in daily Free World oil production. These are considered the most likely disruption scenarios. In 1980, one source estimated a one-in-five chance of such a scenario occurring for a year's length by the year 2000 (9).

2. Moderate Disruptions - Generally, these include scenarios between 8-19 percent daily Free World production loss. Under moderate disruptions, the U.S. would probably participate in actions undertaken by the International Energy Agency, a 21-nation organization. Such actions include federally imposed consumption restraints and sharing available oil supplies among nations.

3. Major Disruptions - These usually imply a loss of approximately 20 percent or more of daily Free World oil production. These are generally classified as major Middle-East war scenarios.

4.2.3 Describing the Next Disruption

Any minor or even moderate disruption occurring in the near term (to around 1985) will probably not last as long as most of these scenarios. There is enough underutilized production capacity existing in the world that a production cut by one or more countries will be made up soon by other nations. The near-term glut is furthermore a disincentive to politically or economically motivated disruptions of any length. The uncertainty factor is likely to be diminished, however, as refiners, distributors, and consumers avoid widescale stockpiling in expectation of a quick resumption of world supply and a quick stabilization of prices. Furthermore, the main government response to a disruption in the near term (in the U.S. and elsewhere) is likely to be a) encouragement of expanded crude oil production in the case of minor disruptions, and b) drawdown of strategic stockpiles in the case of moderate disruptions. Whereas the effectiveness of these actions can't be fully assured, they are not likely to feed spot market price increases as past actions did.

By 1985, however, demand for oil products is estimated to increase by an estimated 4-12 percent (10). At the same time, OPEC's share in world production will have increased also, from 46 percent in 1982 to 52 percent (24). In this somewhat tighter market, with greater control restored to

OPEC, disruptions of varying length and size are possible. Or, as a former OPEC official termed it, unavoidable: "...every upswing of the business cycle would inevitably produce an imbalance between growing demand and constrained supply," an imbalance vulnerable to disruption and unlikely to be buffered by other producing nations (12).

If the next disruption does not occur until the later 1980s, it could have serious and detrimental effects, even if it is a minor disruption. The fear that a small, sudden disruption may evolve into a larger disruption has in the past induced private stockpiling during shortages (especially when inventories were low to begin with), which in turn has exacerbated oil supply and price conditions. The uncertainty as to when or even if vast government-held reserve supplies will be released to make up the shortage certainly will not cause private stockpiling during a crisis to abate. As Verleger has shown, unless worldwide production can be increased to a level that satisfies both total consumer demand and the demand for inventories, a disruption as small as one million barrels per day for six months can cause "a prolonged reaction that might result in a destabilizing cycle of price increases and inventory accumulation (13)."

#### 4.2.4 Summary and Related Questions

In summary, disruptions in the world supply of oil are possible at any time. They have been as small and as short as 0.1 million barrels per day in May 1979, while the potential exists for a one-year loss of 19 million barrels per day (36 percent of world production) (14). In the past, relatively small disruptions have had major consequences because of the suddeness with which they occurred, the uncertainty about their length and magnitude, the low level of inventories when they began and some responses made by government. In the near-term future, deliberate disruptions are unlikely (and uncontrolld ones are unlikely to last long), despite low inventories, because of excess oil production capacity in the world. After 1985, however, much of that capacity will be utilized to satisfy growing demand, and the world will again be susceptible to disruptions, deliberate or not, short or long. Small disruptions may once again pose a problem, along with larger disruptions.

Three related questions are also addressed in this section. First, what about major disruptions? As pointed out, these are generally war scenarios, considerably more serious than the 1980 Iran-Iraq war but not necessarily World War III scenarios. Still, the effects of such a war scenario encompass so many military, political, economic and social impacts and responses that the scenario simply transcends the issue of public transportation fuel supply. Additionally, any major disruption would necessitate major government controls of some type, as the free market would be faced with a depression-like blow. For these reasons, major disruptions are not considered in this report.

Second, what if disruptions do not strike directly at U.S. oil sources? The interrelationships among suppliers and consumers, discussed in Chapter 2, cross international boundaries. Most major oil companies in the world are multinational, and:

> "...as a result, oil supplies will move rapidly to regions with high prices and away from regions with relatively low prices until prices in all regions are about the same.... During supply disruptions,

the forces of price equalization will bring about an efficient sharing of available supplies. All consuming countries will experience an approximately equal shortage, measured as a proportion of their demand before the disruption, regardless of whether a consuming country's source of crude is also the source of the disruption (15)."

Third, what is the potential for regional disruptions within the U.S.? Disruptions in the normal flow of oil products occur continually in the U.S., due to weather, equipment, labor and other problems. As a result, competitive firms often rely on each other to assist in such situations, purchasing fuel from one another to make up unforeseen shortfalls. This is a built-in part of the regional oil movement logistics which Table 2.1 displayed. But it is the larger unforeseen disruption of foreign oil that has many concerned. In 1978, it was stated that because "New York's petroleum supply is more foreign-dependent than the U.S.'s generally, ...New York would be affected to a greater degree than the rest of the country in the event of [a Middle East] embargo (16)." Indeed, in 1979, gasoline lines appeared in New York State, but not in many other states. However, that was due more to allocation regulations than to dependence upon foreign oil. In a free-market setting, the logistical structure should function in foreign-caused disruptions as it does during domestic disruptions: matching supply to demand. It is true, however, that whatever current cost differential for oil products New York vs. Texas will be maintained during a disruption, and possibly increased on the basis of what the New York vs. Texas market can bear. These issues of actual supply and price of oil products during a future disruption are dealt with more extensively in the next two sections.

## 4.3 What Will Happen to Supply of Oil Products?

### 4.3.1 Experience of Past Disruptions

The previous section showed that for reasons of uncertainty and various government actions, the amount of oil products supplied by refiners and distributors during a disruption has not been related to the actual amount of crude oil available at that time. Paradoxically, price and allocation controls imposed by the Federal government during these periods as a means of providing some stability to a disrupted market tended to exacerbate the situation. In explaining this paradox, the following distinction is made: disruptions cause a reduction in supply, but price and allocation controls cause shortages. Figure 4.1 (a through d) explains the distinction. Figure 4.1a shows the oil market prior to a disruptive period. The equilibrium ($E_1$) between consumer demand for oil products ($D_1$) and the supply of oil products ($S_1$) determines the price at which products are sold ($P_1$) and the quantity consumed ($Q_1$). In Figure 4.1b, a disruption causes an overall reduction in supply (back to $S_2$). A new equilibrium ($E_2$) is eventually reached at a point where the price is higher ($P_2$) and the quantity demanded is lower ($Q_2$). The new equilibrium is reached through price-induced conservation, and as a consequence, there exists enough available supply to satisfy all consumers willing to pay the higher price. (Latent demand for oil products at lower prices exists, however, and remains unsatisfied.)

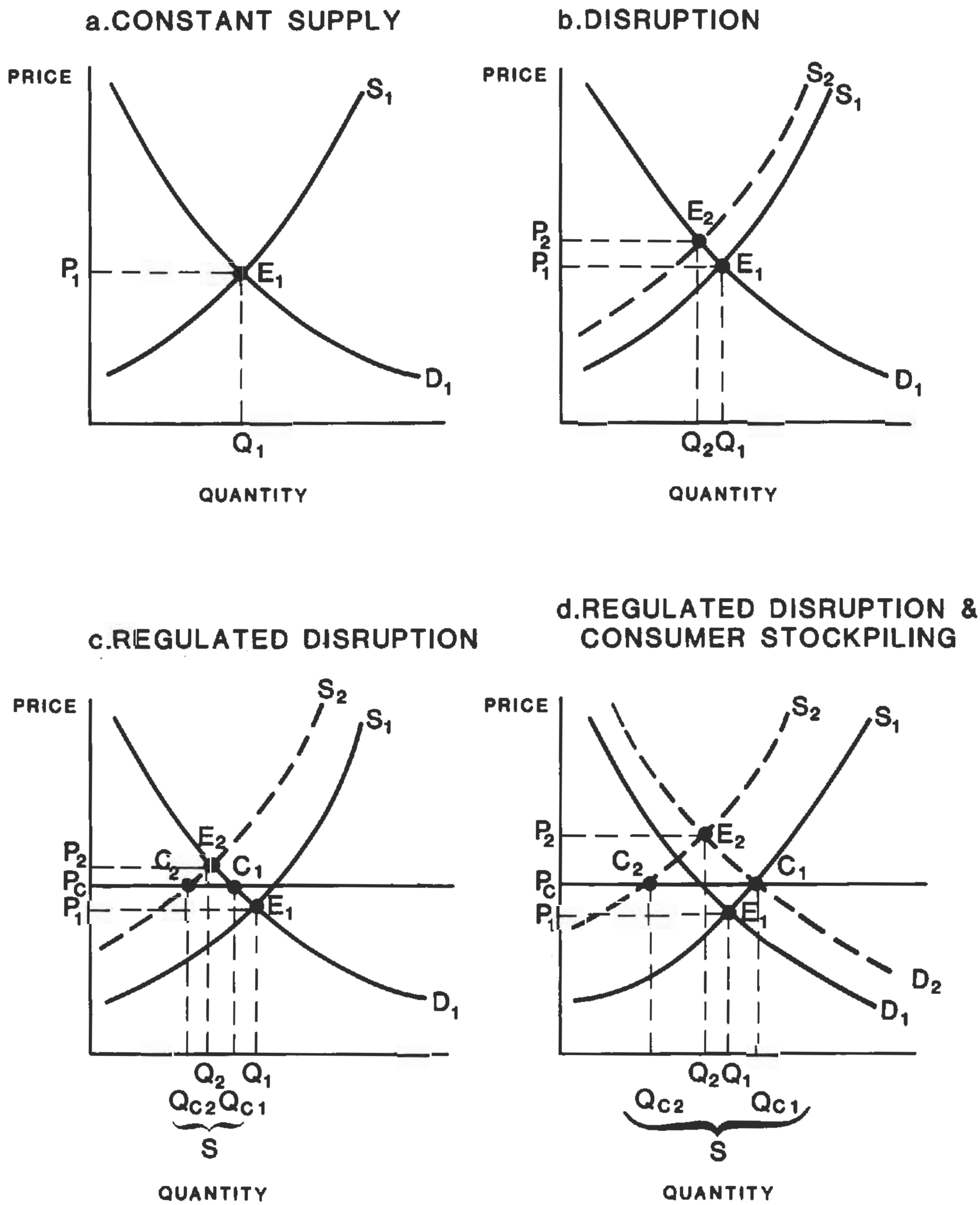



FIGURE 4.1

THE EFFECTS OF REGULATED OIL
DISRUPTIONS: AN ECONOMIC ANALYSIS

Figure 4.1c shows the effects of price controls. The equilibrium ($E_2$) price is not reached; instead a new price is set ($P_c$), not by the market but by regulation. ($P_c$ is between $P_1$ and $P_2$ because it represents the average of frozen domestic crude oil prices and the higher imported oil prices.) At price $P_c$, consumers perceive a different equilibrium point ($C_1$) and consequently demand an amount ($Q_{c1}$) which is less than pre-disruption demand ($Q_1$) but more than would be demanded under a nonregulated disruption ($Q_2$). The problem that arises is that suppliers perceive a completely different equilibrium point ($C_2$), and are willing to make only a considerably smaller amount of oil products available ($Q_{c2}$). The difference between $Q_{c1}$ and $Q_{c2}$ is a shortage (S); it represents the difference in what consumers demand at a certain price and what suppliers are willing to offer at that price. Gasoline service station lines are the most prominent representation of a shortage in action.

The situation becomes exacerbated when, in the early stages, consumer uncertainty about the length and magnitude of the disruption causes demand (for stockpiling purposes) to increase. Such actions as automobiles topping off and farmers filling storage tanks to the maximum cause demand to shift, as shown in Figure 4.1d from $D_1$ to $D_2$. The surge in demand means that, in an unregulated environment, prices ($P_2$) would be even higher but that the reduction in quantity available ($Q_2$) would not be as large. However, price controls produce the distinct consumer and supplier equilibrium points ($C_1$ and $C_2$, respectively) and result in an even larger shortage ($S=Q_{c1}-Q_{c2}$).

Allocation controls work in accord with price controls. As Figure 4.1c shows, when prices are controlled at $P_c$, consumers demand $Q_{c1}$ but suppliers will only offer $Q_{c2}$. Allocation controls are imposed so that the resulting shortage is allocated proportionately to consumers according to a methodology derived either by government or by suppliers but not by the market. Such controls are purported to allocate shortages in an equitable manner, but it is also clear that such controls "tend to be based on convenient administrative rules, intuitive allocation principles, moral judgments as to desirable and undesirable uses of energy in an emergency, and...political pressures" (17). As a result, inefficiencies have arisen. In May 1979, government controls distributed the ensuing shortage proportionately according to a May 1972 base period. Due to Sunbelt population growth from 1972-1979, some states such as California and Florida were receiving outmoded and inadequate allocations. Subsequently, a new base period (October 1978) was substituted. This involved a seasonal distortion, however, resulting in inadequate gasoline supplies in vacation sites in June 1979. In July, allocations to rural and resort areas were increased, but by then, many vacation plans had been cancelled. As a result, cities like Washington, DC faced severe gasoline shortages, while along the New Jersey shore and in the rural Midwest surplus conditions existed (18). In 1979, allocation controls always lagged behind consumer demand conditions.

### 4.3.2 Two Scenarios for Future Disruptions: Market and Institutional

There are two distinct future scenarios to consider: the market scenario and the institutional scenario.

Under the market scenario, a disruption will cause a reduction in U.S. oil supply, as Figure 4.1b showed. At the same time, demand may temporarily surge depending upon consumer uncertainty, as Figure 4.1d indicated. Through market actions, the available supply will be shifted from distributors and consumers who are unable or unwilling to pay the higher price to those who will pay the price. On the individual level, consumers evaluate their position and either conserve fuel (i.e., defer purchases) or purchase their current needs. In the aggregate, a new equilibrium is reached at a higher price and a lower level of consumption, shown initially in Figure 4.1b and 4.1d as $E_2$. Without price or allocation controls to hinder microeconomic decision making, three things should happen: a) a new equilibrium should be reached quickly (unless the supply curve shifts again), b) shortages similar to those which occurred during previous disruptions should not occur, and c) consumers who can afford market-clearing prices should receive all the supplies which they demand.

The institutional scenario asserts that there are enough interceding factors to distort basic supply and demand processes such that the consequences of the microeconomic scenario will not occur as predicted. Let us review the three basic market effects of an unregulated disruption, and note the abberations which could occur, defining the institutional situation:

1. "A new equilibrium should be reached quickly." Conservative pricing policies by suppliers could stall the movement toward equilibrium. OPEC, for example, has in the past waited until after disruptions were over to formally raise contract prices (19). U.S. oil producers, fearing negative public (and Congressional) response to market-clearing prices and resultant profit levels, might be inclined to raise prices slowly and incrementally (20). Finally, posted-price provisions in most oil product contracts restrict the speed and criteria by which prices can be raised (21). The aggregate consequence of these conditions would be a slow, possibly erratic increase in oil prices and therefore a slow movement toward a new supplier-consumer equilibrium.

2. "Shortages should not occur." Slow and uneven movement toward a market-clearing price could simulate the effects of price controls and produce shortages at various times, in various parts of the country and for different types of consumers. Furthermore, shortages which might arise may not necessarily be mitigated by a shift in supplies by producers and distributors. A number of the major U.S. oil companies publically state that in the face of supply disruptions, they will be legally bound by the Uniform Contract Code (UCC) to allocate their available supplies equitably among all their customers and not divert them elsewhere (22).

3. "Consumers should receive all that they can afford." In the event of shortages and supplier-instituted allocation, even consumers willing to pay dearly for additional supplies could have difficulty obtaining them. It may actually be that when a disruption occurs, some suppliers may

forego self-imposed allocation. At least one source states that UCC guidelines are not applicable to oil markets in the event of a supply disruption (23). But other suppliers may choose to allocate anyway, for other reasons. The integrated nature of the oil industry makes it likely "that inertia will keep firms doing business through their usual channels (24)." Even when formal integrated ownership does not exist, there are enough informal links (e.g., joint pipeline ownership, the network of crude and product exchanges that exist during nondisruption periods) that firms may not want to be seen as "reneging on any one agreement, even if that agreement now seems less profitable than other opportunities (25)." Finally, firms may be interested in achieving a reputation of fairness (by allocating equitably) rather than of benefitting by the crisis. Such a reputation has both short-term benefits (i.e., forestall any movement toward reregulation) and long-term benefits (i.e., maintaining customers after the disruption).

### 4.3.3 Supply During a Future Disruption

During an unregulated disruption, the forces of supply and demand will move to the forefront, but may be tempered by other motives of and restrictions placed upon the oil industry. The movement toward a market-clearing price may be fast and precipitous, in which case supplies will be available to all those who can afford them. Or, price increases may be slow and erratic. But there will be movement, with little or no likelihood of a frozen price level. Firms may allocate supplies, but are likely to do so in the most profitable manner; since firms are free to choose what base consumption period is appropriate, it can be expected that some firms might choose a base which would induce conservation by some consumers, with the unused portion sold off to other existing or new customers willing to pay for it. The key in the unregulated disruption is that even given institutional constraints, individual suppliers are trying to maximize profits. Profit maximization moves the market to a new equilibrium price, albeit slowly. As a result, the new equilibrium price will generally determine the availability of supplies to consumers, but before it is reached, there is a distinct possibility that other factors may cause shortages and allocation to occur.

## 4.4 What Will Happen to the Price of Oil Products?

### 4.4.1 Experience of Past Disruptions

In the past, the combined effects of domestic crude oil price controls, oil product price controls and the sluggishness of OPEC in raising crude oil contract prices resulted in only moderate price increases for consumers during supply disruptions. Between October 1978 and October 1979, heating oil spot market prices rose an average of 9 percent monthly (uncorrected for inflation), but most consumers experienced an increase of only 4 percent monthly (even though heating oil prices were unregulated) (26). When accounting for inflation, the constant average price increase for contracted heating oil (vs. spot market) was less than 2 percent monthly (27). The following year, however, when supply was fully restored (for most of the year) the constant price of contracted heating oil rose at the higher average monthly rate of 3 percent (28).

### 4.4.2 Product Prices During Future Disruptions

There are many models which predict fuel prices during an unregulated disruption. Two in particular are relevant to this study because a) they address distillate fuel prices in particular, and b) reflect the dichotomy between the market and institutional scenarios discussed earlier (29). Both models address minor and moderate disruptions as defined earlier. While both are econometric models, the so-called market scenario model is a complex econometric model which evaluates a wide range of economic relationships, while the so-called institutional model is a considerably simpler model focusing on oil market relationships.

There is a significant difference in expected distillate fuel prices depending on whether or not institutional factors in fact do interfere with market adjustments to supply disruptions. In a minor disruption, a new equilibrium price for diesel fuel could be reached almost immediately and be more than 75 percent higher than the pre-disruption price (30). If institutional factors arise and dominate, the price increase could be limited to less than 10 percent by the end of the disruption (31). In a moderate disruption, the difference is even wider: an equilibrium price nearly three times higher than pre-disruption price vs. a 35 percent price increase by the disruption's end if institutional factors intervene (32).

One may infer from the results that consumers benefit in terms of price when institutional factors dominate. While this is true (not only for the institutional model but also for the case of a regulated disruption), the lesson of past disruptions is that relatively low product prices during disruptions contribute to higher long-run prices after the disruption ends. In theory, the relatively quick establishment of high price levels indicated by the market model should a) end stockpiling and begin disbursement of inventory, b) cut consumption, c) stabilize spot market increases, and most important, d) reduce the magnitude or even the likelihood of long-term contract price increases by OPEC or other nations after the disruption ends because of insufficient demand to meet those prices.

## 4.5 What Role Will Government Take?

### 4.5.1 Experience of Past Disruptions

Previous sections of this chapter and material presented in Chapter 2 showed that Federal involvement in prior disruptions consisted of regulations, incentives and voluntary actions. The intention of all these responses was multi-faceted, but primarily was directed toward easing the plight of many oil market participants, including consumers and distributors. As a corollary, there was an underlying intent to distribute the hardships of disruptions in an even-handed way. Therefore, price controls were justified as restricting oil company profits and allowing lower income groups to afford oil products. The crude oil buy/sell and entitlements regulations were to benefit smaller, independent refineries and to secure their operations through disruption periods. Supply allocation rules were intended to protect, preserve and maintain various things (e.g., public health and services, key industries, and competetive oil industry) (33).

State governments were heavily involved in prior disruptions also. A great deal of time and manpower was devoted to the federally-instituted set-aside programs. In the state of Washington, for example, the equivalent of 22 full-time employees administered the set-aside program in 1974; by 1979, the program was run more efficiently but still necessitated the equivalent of seven full-time employees (34). Various states instituted measures dealing directly with gasoline station sales: odd-even, minimum fill-up/purchase, minimum operating hours, Sunday openings (35). Dissemination of information was another major action, especially as it concerned a) the availability of gasoline, b) fuel conservation tips, and c) marketing of public transportation and ride sharing alternatives (36).

The objectives of state efforts were also multi-faceted, but can generally be summarized as

1. maintenance of public calm and order;
2. maintenance of essential services;
3. maintenance of personal mobility; and
4. minimization of economic hardship.

It can be safely stated that for both Federal and state government, ending disruptions quickly was not a major objective. This is not to imply ulterior motives, but to suggest that the types of steps government needed to help end disruptions were strong, unpleasant and not in accord with many other objectives.

4.5.2 Current Governmental Authority (Circa 1983-84)

It has recently been stated that there are many existing laws which

> "...provide the President with authority that may be available in the event of a substantial domestic or international shortfall in petroleum supplies, ranging from direct authority to allocate and to restrict imports or exports of petroleum products, to authority to undertake or facilitate energy emergency preparedness planning and programs (37)."

Realistically, however, there are two main measures that the Federal government has authority to implement and would be inclined to implement in the present (1980-84) Federal Administration in the event of disruptions. These measures are disbursement of Strategic Petroleum Reserve (SPR) supplies and interaction with International Energy Agency programs.

The SPR was created in 1975 to act as "the nation's insurance policy against energy insufficiency (38)." Up to one billion barrels of crude oil was to be held in existing salt caverns in Texas and Louisiana and in other undesignated sites. However, by the beginning of 1979, less than 7 percent of the anticipated capacity had been filled and no viable plan for drawing down reserves was available (39). (Thus it was not a practical insurance measure for the Iranian disruptions.) Beginning in 1980, a larger fill rate was authorized, so that by late 1983 about 375 million barrels were in the SPR (40). By mid-1986, the SPR should hold 500 million barrels (41). Beyond that date, no authorized fill plans exist.

SPR sites are tied into existing Gulf Coast pipelines and docks, facilitating quick access to supplies. It is expected that the four varieties of crude available in the SPR would primarily go to Midwest, Gulf Coast and East Coast refineries (42). Other areas could be served through exchanges that are part of current operating practices.

Three critical questions related to the SPR are 1) when would it be drawn upon 2) at what rate, and 3) who would receive the supplies? To the first question, there is currently no definitive answer. There is no trigger mechanism for releasing SPR oil and the current Federal administration resists any such preset formula because of the "wide range of unpredictable conditions which might characterize an energy supply interruption" (43). However, there is considerable opinion that the SPR should not be used during a minor disruption.

In terms of the second question, the drawdown rate, this too is unfixed, for the same reasons of uncertainty. As USDOE states,

> "During an actual emergency, the drawdown rate decision will be continuously modified and reflected in subsequent sales in order to be responsive to changing oil market events (44)."

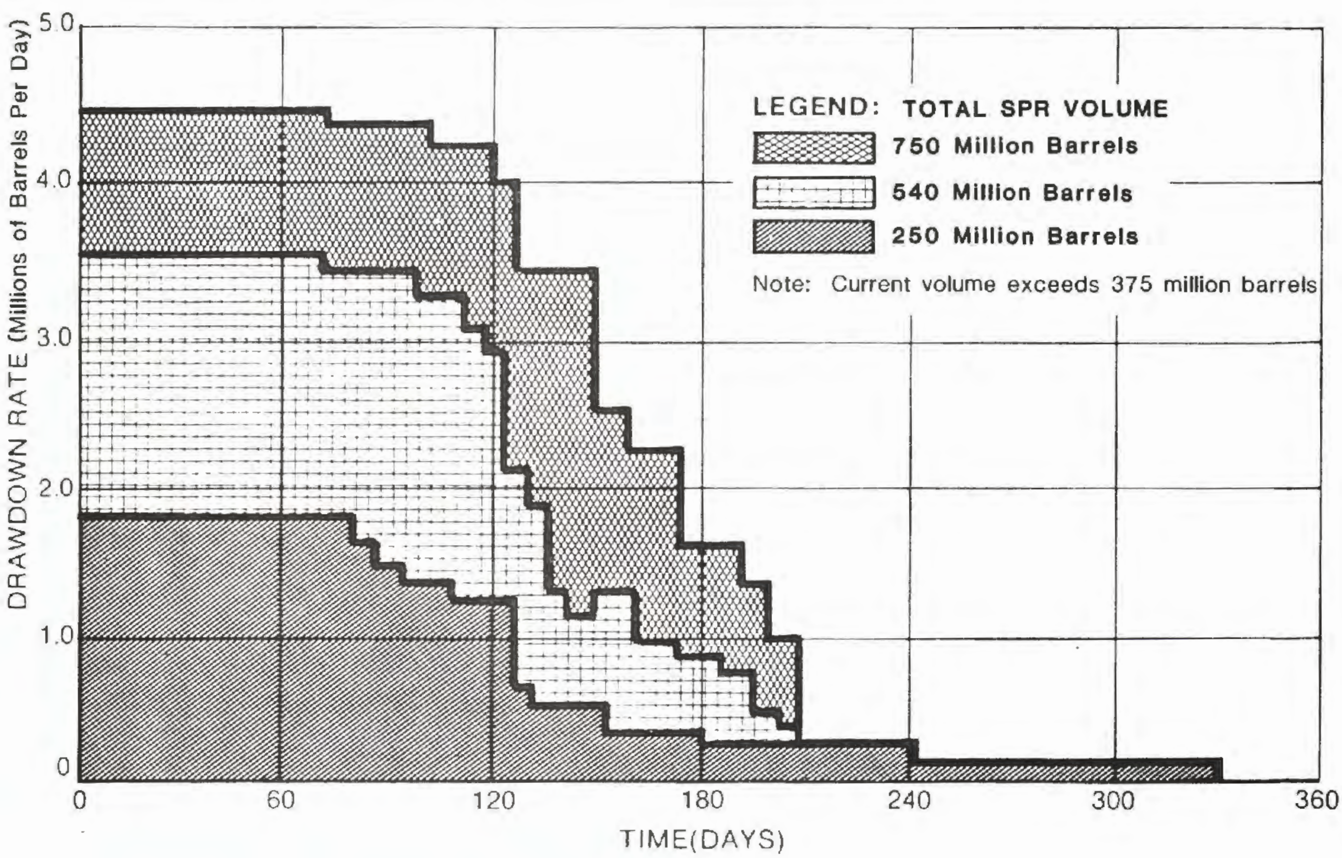
The maximum drawdown capability for the SPR at various levels of volume is shown in Figure 4.2. It indicates an ability to supply a substantial portion of supply for at least a four-month period. Obviously at lower drawdown rates, the SPR could buffer against a year-long moderate disruptions.

As to the third question (who would receive SPR supplies), the answer in early 1984 is essentially anyone who can afford it. The Federal government has proposed that at least 90 percent of the SPR supplies which are to be distributed in a given month would be sold via a price competitive auction. USDOE would issue a notice of sale, offering a set quantity of fuel available in different size lots, in order to fit SPR sales into a free-market response to a disruption,

> "The universe of eligible buyers will not be restricted, except insofar as necessary to assure performance and payment. Thus, all interested buyers will be eligible to bid for and purchase SPR oil... (45)."

As much as 10 percent of SPR oil released in a given month could however, be directed toward certain buyers, chosen at USDOE's discretion. The price offered would be the average of the auction results.

The second major measure in which the Federal government is authorized and committed to participate in is the contingency program of the International Energy Agency (IEA). IEA members include 21 of the world's developed countries. At the heart of the program is an agreement whereby all IEA members would share available oil supplies if a disruption of more than 7 percent of worldwide crude oil production occurred. The U.S. and other members would be committed to make a significant reduction in oil consumption and, if need be, allocate supplies to needy members.




Source:

National Petroleum Council, Emergency Preparedness for Interruptions of Petroleum Imports into the United States, Washington, D.C., April 1981, p. 104.

FIGURE 4.2

MAXIMUM DRAWDOWN CAPABILITY OF THE SPR AT VARIOUS FILL VOLUMES

The IEA membership would need to vote a declaration of an emergency sharing condition, but only the President could formally activate U.S. participation. Legislative authority is available for the President to meet all IEA commitments. It is conceivable, therefore, that if the U.S. were to fully meet IEA requirements during certain moderate disruptions, that a) the Federal government might find it necessary to reimpose internal crude and product supply allocation in order to compensate for supply diversions to other nations, and b) it might impose voluntary or mandatory demand restraint measures.

State governments have taken their own intiatives toward meeting future supply disruptions. About half the states have passed or are considering passing legislation that would create fuel set-aside programs (46). Oil companies and the American Petroleum Institute are making a major effort to advise states about these programs, suggesting a limit on the types and amount of fuel that should be set aside, as well as requesting that these supplies be redirected to users quickly and not held in abeyance for a period long enough to worsen supply conditions (47). Besides set-aside programs, at least 30 states have enacted legislation containing broad allocation/rationing/distribution/conservation provisions, including equitable allocation guidelines, energy conservation measures and suspension of standards considered energy inefficient (e.g., pollution control standards)(48). Nearly every state has energy emergency or disaster emergency legislation capable of granting the Governor a wide range of powers beyond those detailed here in the event of energy contingencies.

#### 4.5.3 Other Possible Government Responses

Obviously, the Federal government is not constrained to only current actions which have been officially noted as its candidate actions in the event of some future oil supply disruption. Legislative or administrative actions could be taken to give the Federal government a larger role as an interventionist in market activities. As an example, in Spring 1982, Congress overwhelmingly passed legislation that gave the President considerable standby energy emergency powers, including supply allocation controls. The President vetoed the bill, but what was demonstrated was strong support for government action and distrust of market processes, as also expressed in Congressional reports with such titles as The United States Remains Unprepared for Oil Import Disruptions and Managing Oil Disruptions: Issues and Policy Options (49). The following identifies possible government responses to disruptions and assesses their likelihood of implementation.

1. Economic Response Measures - One USDOE official calls these "an absolutely vital part of any kind of emergency response procedure," although they are not currently in place (50). The objective is to respond to the large transfer of income from consumers to oil suppliers (foreign and domestic) and to the Federal government (via the Windfall Profits Tax) in the event of a disruption. Many proposals exist, but the one most commonly expressed is a general rebate to all taxpayers (51). Institutionally, this could be implemented quickly by changing income tax withholding rates. Another proposal is to implement block grants to states, with or without detailed guidelines on disbursements. Financing for block grants could come from the Windfall Profits Tax, general revenues or SPR sales income. These and other measures are being studied by USDOE, which is likely to recommend some actions in the near future.

2. SPR Proposals - Two widely different proposals exist for distributing SPR oil in a manner other than planned as of this writing (i.e. 1983-84). One would be to distribute SPR supplies by allocation to U.S. refiners at a fixed price (52). Another would be that rather than auction the oil itself, USDOE would auction, ahead of time, options on the oil, allowing any interested buyer to purchase high-priced SPR supplies for a limited period of time (53). The purpose is to more completely mesh SPR use with market activity by shifting the responsibility of deciding when to use it to the private sector. Neither proposal is being actively studied or pursued at this time.

3. Gasoline Rationing - Implemented in conjunction with gasoline price controls (as well as with price controls on crude oil and price/allocation controls on other products), coupon rationing would replace service station queues and would be effective in cutting gasoline consumption (54). While rationing is a less efficient means of allocating supply reductions than free-market prices, it would avoid the major income shifts that unregulated disruptions allow and would result in a relatively quick reduction in demand. However, the institutional requirements of a coupon-rationing program are staggering (e.g., manpower, financing, information) and would necessitate considerable lead time. There is also considerable room for error and fraud. (The standby rationing plan which existed from 1980 until 1981 printed coupons which were highly susceptible to forgery and which were interchangeable with one-dollar bills in change-making machines.) All rationing activity has been terminated at USDOE and there are no current proposals to reinstate it. The greatest likelihood for rationing to be implemented would be during a lengthy, major disruption.

4. Tax Proposals - These are numerous. Two U.S. senators have proposed an emergency tax on gasoline (with price controls on other products) (55). The purpose would be to simulate the market process of reaching a new price/demand equilibrium (but for gasoline only, the key petroleum product) without transferring the added income to oil suppliers. Tax revenues would be rebated to motor vehicle owners. Another proposal would place a large tariff on imported crude oil and products at the onset of a disruption (56). While the tariff would be rebated, suppliers of domestic oil would be free to adjust their prices to the new import-plus-tariff price (and be exempt from the tariff, although subject to the Windfall Profits Tax). The objectives are to quickly reduce consumption and reduce stockpiling. The former proposal has some Congressional support, while the latter has been proposed only in a lesser form by the Federal administration as a means of reducing imports and raising revenues during non-disruption periods (57).

5. Reinstating Full Price/Allocation Controls - While there is considerable criticism of how these controls worked in the past, there are proponents for their reinstitution during a disruption. Although it recommends maximum reliance on market processes, the National Petroleum Council would support both the sharing of crude oil supplies and standby price/allocation controls for products during major disruptions (58). Some oil companies, such as Sun Oil, have similar opinions, although others, such as Exxon, totally disavow support for controls (59). USDOE does not support standby regulations because they are likely to reduce private

sector preparedness. But in the event of major disruptions, there is a likelihood that price/allocation controls will be seriously considered along with rationing and other interventionist measures.

## 4.6 Summary

Scenarists are largely concerned with the possibility of disruptions longer and of greater magnitude than those in the past. Minor disruptions are minor in name only; their impacts could be greater than previous disruptions. Moderate disruptions are likely to invoke worldwide release of strategically held reserves (which did not exist in the 1970s), but impacts will still be severe. Major disruptions are likely to be wartime events, requiring war-related responses. This work is interested in the realm of private and public planning and actions during more normal economic, political and social conditions; thus, major disruptions are not the concern of this work.

In the past, the supply of petroleum products to consumers was directly affected by Federal price controls and supply allocation rules. They created shortage conditions and at the same time ineffectively managed these shortages. Price and supply controls have since been eliminated. In the next disruption, a free-market environment could ensure enough supplies available to those able and willing to afford the higher prices. Shortages would not occur. But a free-market environment could still be altered by legal and institutional constraints (even by the constraints of good business practices) which could result in shortages for some consumers. The so-called market vs. institutional models indicate effects which are not necessarily divergent but rather represent the extremes of a rapid vs. a slow readjustment toward a new price-demand equilibrium caused by a change in supply.

While past disruptions caused immediate spot market price changes, the overwhelming majority of consumer oil products are purchased on a contract basis and these prices increased on a considerably smaller scale during previous disruptions. However, contract prices continued to increase even after disruptions ended (and spot market prices stabilized), often at higher levels. In an unregulated environment, consumer prices could theoretically increase to the spot market level, but institutional constraints could limit consumer price increases to a considerably lower level. The savings resulting from the impact of constraints are short-term, however, as far as consumers are concerned (i.e., post-disruption price increases will follow) and tend to enforce conditions which extend the disruption.

The Federal government is likely to assume a markedly different role in future disruptions than in past ones. For the first time it may have an adequate volume of strategic fuel reserves to distribute. It may also engage in international programs. Clearly, Federal objectives have shifted considerably from easing the plight of disruption victims in an equitable manner to curtailing disruptions through economic adjustment. To meet the latter objective, the following have been implemented or proposed:

- elimination of price/allocation controls;
- SPR distribution by auction;
- auction of SPR options;
- a tax on imported oil.

To ease the difficulty of economic adjustment, tax rebate and block grant programs have also been studied.

By no means does this shift in the Federal objective or the means to fulfill it have widespread support. Congress is a large source of some skepticism. Even elements of the oil industry itself voice concern about public backlash against the economic adjustment approach. To this end, regulatory proposals such as the following have been advanced:

- SPR distribution to refineries only by allocation;
- gasoline rationing;
- gasoline tax;
- reinstitution of price/allocation controls.

The likelihood of these proposals being implemented increases with the length and magnitude of a disruption. A major disruption will almost certainly require a new regulatory framework.

The role of state governments is likely to be very similar to that assumed in previous disruptions. Many have reinstituted set-aside programs and will expend a large amount of resources on those programs. Overall objectives concerning public order, essential services, mobility and economic hardship will remain intact. Some states could view the free-market approach as a vacuum rather than a shift in emphasis and may attempt to institute statewide regulatory programs which replicate the Federal approach of the 1970s. Most states have the specific or general authority to do so, but the bureaucratic burden of such steps (e.g., statewide allocation) is a strong disincentive.

# CHAPTER 5

# THE LIKELY EFFECTS OF FUTURE DISRUPTIONS ON TRANSIT SYSTEMS AND ALTERNATIVE ACTIONS TO REDUCE THOSE EFFECTS

## 5.1 Introduction

Within the framework of uncertainty laid out in Chapter 4, how can the effects of future oil disruptions on transit systems be predicted? The most effective answer is an adaptation of the alternative scenario approach. This work utilizes the two models briefly discussed in Chapter 4 -- the market model and the institutional model -- and presents the assumptions and findings from their application as alternative scenarios of what future oil disruptions may resemble. Within these structured scenarios the implications for transit systems are discussed.

Section 5.2 presents the scenario approach. Within defined limits of disruption size and duration, the scenarios indicate the implications for diesel fuel price and supply. Section 5.3 applies these results to a cross-section of the nation's transit systems, using six large and moderately sized transit systems as case studies. Throughout the duration of the disruption scenarios, the following impacts on transit systems are described:

1. Impact on fuel costs;
2. Impact on the annual fuel budget;
3. Availability of fuel supplies;
4. The cost and supply impacts of maintaining the current level of bus services;
5. The cost and supply impacts of increasing the level of bus services to meet areawide contingency needs.

Section 5.4 summarizes these impacts. Section 5.5 proposes six alternative actions by which to help relieve the impacts of disruptions on transit systems.

## 5.2 Oil Disruption Scenarios

### 5.2.1 Basic Framework

There are two basic scenarios--market and institutional--and two disruption levels are considered for each. The scenarios were defined in Section 4.3.2. Basically, the market scenario holds that market forces will cause a new equilibrium to be reached quickly, avoiding shortages, and providing consumers with all they can afford. The institutional scenario holds that there are enough interceding factors to distort basic supply and demand processes such that the market forces cannot act as predicted.

There are no set definitions of either minor or moderate disruptions (the two levels considered), although generally a seven percent loss in free world oil production is considered the dividing line between the two, since only above that amount can I.E.A. nations elect to share supplies and allocate shortages. The scenarios used in this work to reflect the differences between the market and institutional viewpoints are not exactly alike, because of different assumptions made by various scenarists or modelers. (The models are described in more detail in Appendix A.) But the magnitude of production loss is similar as is the effect on U.S. supplies, and the duration of the scenarios are also similar. They are described below:

1. Minor Disruption - Market Scenario (1)

Free world oil production is cut by 1.2 million barrels per day for a one-year period (representing, in today's market, only about a three percent loss in production). However, the reduction is aimed entirely at the U.S. through an embargo action, so that U.S. imports are reduced by 1.2 million barrels (or 25 percent) and total U.S. supplies are cut by eight percent. The scenario, while useful in estimating the price impacts of an eight percent loss in current U.S. supplies, is not a highly probable one. Embargoes are not generally successful, as the 1973 Arab Oil Embargo showed, since other nations and the spot market serve as a source of oil to the U.S. More likely to occur under this scenario is that the U.S. would purchase supplies elsewhere and that in general all nations (including the U.S.) would suffer a three percent loss in supplies.

Furthermore, in today's market, where a significant portion of the world's producton capacity remains underutilized, it is not very likely that such a relatively small disruption would last for a full year. The nation or nations conducting the embargo would either be forced by market pressure and lost income to reinstate production or other nations would pick up the slack, thereby negating the disruption. This process might take no longer than two to three months but certainly far less than a year. However, in a tighter, post-1985 market where greater production capacity is utilized, the probability of a year long disruption rises.

Despite these caveats concerning the scenario's likelihood of occurring, it is used in unaltered form to indicate the effects of an eight percent loss of U.S. supplies over an extended time period.

2. Minor Disruption - Institutional Scenario (2)

Free world oil production is cut by approximately two million barrels per day for a one-year period, representing a five percent loss in production. U.S. supplies, as are all free world supplies, are cut by five percent, but in addition, U.S. inventory behavior in the primary, secondary and tertiary sectors results in an additional 300,000 barrels per day being demanded for stockpiling purposes. (Stockpiling occcurs, as Chapter 4 discussed, because of uncertainty about the length and magnitude of the disruption, and because slowly rising prices do not discourgage additional demand.) The net effect of a reduction in supplies and an increase in inventory demand is a seven percent loss is current U.S. supplies.

As with the market scenario, the likelihood of a year-long disruption of 5 percent production under current conditions is not high. Furthermore, increased inventory demand, which converts a five percent worldwide shortfall into a seven percent U.S. shortfall, might not be quite so large if a) it was generally assumed at the time that the disruption would last less than a year and b) inventory levels were high to begin with at the disruption's commencement. In the pre-1985 oil demand environment, both these conditions are likely to exist. In a tighter, post-1985 demand environment, neither is likely to exist. The scenario is used in an unaltered form to indicate the effects of a seven percent loss of U.S. supplies over an extended time period.

3. Moderate Disruption - Market Scenario (3)

Free world oil production is cut by five million barrels per day for a one-year period (representing a 12 percent loss in current production), due to production cutback by OPEC of 20 percent. The market scenario determines the U.S. supply loss via a) historical price elasticities, (since it initially determines worldwide price changes), b) reduced needs due to economic slowdown, and c) equitable international sharing of supplies according to IEA guidelines. The result is a 2.3 million barrel per day loss, or a 15 percent loss in current U.S. supplies.

The scenario does not incorporate the release of SPR fuel into the U.S. market, a questionable although not necessarily unlikely assumption.* A year-long disruption of this intensity is likely, given the amount of time necessary for 5 million barrels of non-OPEC production capacity to be put back into operation. Still, in the current environment, the capability of OPEC acting cohesively and effectively to produce a 20 percent production cutback is not strong. Beyond 1985, when OPEC production is likely to be a more significant portion of the world share and, consequently, the cartel more unified, the scenario's likelihood is high.

4. Moderate Disruption - Institutional Scenario (5)

Free world oil production is cut by 6.5 million barrels per day for a one-year period, representing a 15 percent loss in current production. U.S. supplies would likewise drop by 15 percent, or 2.29 million barrels per day. However, the rate of inventory demand soars in this scenario reaching a level of 1.6 million barrels per day by the end of the disruption (which is nearly 70 percent of the U.S. supply shortfall itself). The net effect is a reduction in U.S. oil supplies of 22 percent after the disruption's first month, rising to 26 percent by the end of the disruption, as inventory stockpiles continue.

As with the market scenario version of the moderate disruption, a year-long duration is likely. If preceded by a period of high inventory levels, disruption stockpiling would be reduced somewhat (although the eventual net shortfall would still exceed 20 percent). If SPR fuel was released, and assuming a very large level of release, the full impact of the disruption could be postponed for nearly nine months (and inventory demand maintained at a much lower rate). For the first six months, in fact, the net shortfall would be less than that experienced in the minor disruption scenario. But such use of the SPR would completely deplete its supplies by nine months, an unwarranted and unlikely policy action in light of only a moderate disruption. Therefore, while release of the SPR may be a questionable permutation of this scenario, a high level release is an highly unlikely event. In the end, even SPR release would

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* As recently as mid-1983, when SPR supplies were significant, a USDOE scenario of similar magnitude and assumptions (used to test the IEA sharing process) also assumed no SPR release, stating that market forces and temporarily halting SPR build up were adequte responses (4).

probably only cause a reduction in accelerating inventory demand, but little if no effect on the level of base supply made available to the U.S.

Table 5.1 summarizes the basic characteristics of these disruption scenarios as presented above.

### 5.2.2 Product Supply Impacts

The question posed in Chapter 4 was what would happen to product supply during a disruption. The market viewpoint is that while a shortfall would be apparent, shortages are avoidable. Products would be available in sufficient supply to meet the new, lower demand (reduced by higher disruption prices). The institutional viewpoint is that shortages are likely, for two reasons: a) relatively low prices will not reduce demand to any great extent (and, in fact, will cause increased demand for inventory purposes); and b) due to the imbalance in demand and supply, product distributors are likely to allocate supplies to consumers.

In terms of the scenarios, these viewpoints translate into the following:

- in the market scenarios, transit systems can look forward to receiving all their diesel fuel supplies, as long as they can pay for them. No shortages should occur throughout the duration of the disruption;
- in the institutional scenarios, transit systems can look forward to receiving only a portion of their diesel fuel supplies. Oil distributors could implement any number of shortage allocation plans, but the likeliest is an equitable distribution among all consumers. The best estimate of what that portion will be is the amount of overall petroleum supplies available to the U.S. throughout the duration of the disruption. Table 5.2 shows what that portion may be at different periods of time during minor and moderate disruptions.

### 5.2.3 Product Price Impacts

The market viewpoint holds that new equilibrium prices will be reached relatively quickly during a disruption and that these prices will be considerably higher than current prices. Prices then fall when the disruption ends and production is restored. The institutional viewpoint holds that prices rise slowly during a disruption and continue to do so even after the disruption ends. Prices, however, never reach the levels recorded in a pure market setting.

Table 5.3 shows the levels to which diesel fuel prices would probably rise at different periods of time during (and after) minor and moderate disruptions within market and institutional scenarios. Prices prediced in the scenario models utilize different base prices, but the percentage increases remain the same regardless of the pre-disruption price used. For this work, diesel fuel price is assumed to be $1.00 per gallon prior to the start of disruption.

## TABLE 5.1

## SUMMARY OF BASIC DISRUPTION SCENARIO CHARACTERISTICS

| | | Scenario Types | |
|---|---|---|---|
| Scenario Size | Characteristics | Market | Institutional |
| Minor | 1. Free World Production Loss | 1.2 million barrels daily | 2 million barrels daily |
| | 2. U.S. Disruption Impact: | | |
| | a. Import Loss | 1.2 million barrels daily | 760,000 barrels daily |
| | b. New Inventory | N.A. | 300,000 barrels daily |
| | 3. Total U.S. % Loss | 8% | 7% |
| | 4. Duration | 1 Year | 1 Year |
| | 5. Likelihood | Embargo unlikely, thus U.S. losses likely to be lower. Year-long disruption unlikely. | Duration and new inventory likely to be lower in current demand environment. In tight market, very likely scenario. |
| Moderate | 1. Free World Production Loss | 5 million barrels daily | 6.5 million barrels daily |
| | 2. U.S. Disruption Impact: | | |
| | a. Import Loss | 2.3 million barrels daily | 2.29 million barrels daily |
| | b. New Inventory | N.A. | 1.6 million barrels daily |
| | 3. Total U.S. % Loss | 15% | 26% |
| | 4. Duration | 1 Year | 1 Year |
| | 5. Likelihood | SPR non-release questionable. Likely tight market scenario. | SPR non-release questionable: if fully released, impacts would be less than minor disruption. Smaller SPR release likely, possibly eliminating new demand. |

N.A. = Not Applicable
SPR = Strategic Petroleum Reserve

TABLE 5.2

DIESEL FUEL SUPPLY DURING INSTITUTIONAL SCENARIOS OF MINOR AND MODERATE DISRUPTIONS

| Time Period | % Diesel Fuel Made Available to Transit Systems During: Minor Disruption | Moderate Disruption |
|---|---|---|
| Immediately prior to disruption | 100% | 100% |
| One month after disruption begins | 98%[a] | 93%[a] |
| Three months after disruption begins | 93% | 77% |
| Six months after disruption begins | 93% | 76% |
| Nine months after disruption begins | 93% | 75% |
| One year after disruption begins; disruption ends at this point. | 93% | 74% |

[a] After one month, the only shortage is due to added inventory demand. After two months, all imports bound for the U.S. at the commencement of the disruption have reached their destinations. From that point on, the U.S. is subject to new production conditions and any further increased inventory demand (under the moderate disruption).

Source: Based on information in USGAO, Oil Supply Disruptions: Their Price and Economic Effects, Washington, D.C., May 20, 1983.

TABLE 5.3

DIESEL FUEL PRICE DURING MARKET AND INSTITUTIONAL SCENARIOS OF MINOR AND MODERATE DISRUPTIONS

| | Diesel Fuel Price ($ per gallon) During a | | | |
|---|---|---|---|---|
| | Minor Disruption: | | Moderate Disruption: | |
| Time Period | Market Scenario | Institutional Scenario | Market Scenario | Institutional Scenario |
| Immed. prior to disruption | $1.00 | $1.00 | $1.00 | $1.00 |
| One month after disrup. begins | $1.77 | $1.00 | $2.83 | $1.00 |
| Three months after disrup. begins | $1.77 | $1.02 | $2.83 | $1.05 |
| Six months after disrup. begins | $1.77 | $1.04 | $2.83 | $1.15 |
| Nine months after disrup. begins | $1.77 | $1.06 | $2.83 | $1.25 |
| One year after disrup. begins; disruption ends at this point. | $1.77 | $1.09 | $2.83 | $1.35 |
| Nine months after disrup. ends | Declining | $1.13[a] | Declining | $1.46[a] |

[a] Nine months after disruption ends, prices reach their peak.

Sources: Larry R. Johnson, et. al., "Economic Impacts of Petroleum Shortages and the Implications for the Freight Transportation Industry," presented at the 61st Annual Transportation Research Board Meeting, January 1982, and USGAO, Oil Supply Disruptions: Their Price and Economic Effects, Washington, D.C., May 20, 1983.

## 5.3 Transit System Impacts

### 5.3.1 Case Study Transit Systems

Information on current diesel fuel procurement procedures of transit systems presented in Chapter 3 was gathered primarily from the experience of six transit systems. These same systems are used to estimate direct impacts of the four oil supply disruption scenarios. The systems are:

1. The New Jersey Transit Corporation (NJTC) - A statewide agency providing bus and rail transit throughout the state and into New York and Pennsylvania as well.

2. The Southeast Pennsylvania Transportation Authority (SEPTA) - This regional bus and rail system is located in Philadelphia and its suburban Pennsylvania environs.

3. The Washington Metropolitan Area Transit Authority (WMATA) - This regional bus and rail system operates in the District of Columbia and extensively in its Maryland and Virginia suburban environs.

4. Chicago Transit Authority (CTA) - This bus and rail system operates in the city of Chicago.

5. Regional Transportation Authority (RTA) - The parent organization with authority over CTA, the RTA actually operates 12 suburban bus and commuter rail services in Chicago and suburban Illinois.

6. The Houston Metropolitan Transportation Authority (MTA) - This regional bus system operates in Houston and its nearby suburban environs.

These systems are all medium and large scale transit systems, as Table 5.4 indicates. The first four, in fact, are among the six largest in the nation. They were chosen to reflect a diversity in a) modes of operations; b) government coordination and responsibility; and c) regional variation in fuel use and availability. That Chapter 3 found a basic similarity in fuel procurement procedures among most of these systems suggests that the concerns and prior experiences of public transportation systems transcend the differences in operational scale, government control and diesel fuel use and availability.

### 5.3.2 Direct Supply/Price Impacts

The impact of disruptions on diesel fuel supply and price for the six selected transit systems is shown in Figures 5.1 through 5.4. (Appendix B shows the Same information in tabular form.) In each figure, the impacts are shown for the first month after the disruption begins and then for the sixth month, midway point into the disruption. Figures 5.1 and 5.2 reflect the basic assumption of the market scenario: supply shortages will not be passed on to consumers in the form of monthly allocations. Therefore, transit fuel supply will not be affected if marketplace practices fully emerge, either under minor or moderate disruptions.

TABLE 5.4

RELEVANT CHARACTERISTICS OF SIX CASE STUDY TRANSIT SYSTEMS

| | Systems: | | | | | |
|---|---|---|---|---|---|---|
| Characterics | NJTC (New Jersey) | SEPTA (Philadelphia) | WMATA (Washington, D.C.) | CTA (Chicago) | RTA (Chicago) | MTA (Houston) |
| Authority | Statewide | Urban area | Urban area; inter-state | City | Suburbs | Urban area |
| Modes | Commuter rail and bus | Subway, Comm. rail and bus | Subway and bus | Subway and bus | Commuter rail and bus | Bus |
| Bus Operations: | | | | | | |
| 1. # buses | 2250 | 1500 | 2000 | 2275 | 575 | 750 |
| 2. # in service | 1800 | 1200 | 1530 | 1930 | 475 | 540 |
| 3. VMT per month | 9.3 million | 2.9 million | 4.4 million | 6.6 million | 1.4 million | 2.3 million |
| 4. VMT per in-service bus per month | 5170 | 2420 | 2875 | 3420 | 2950 | 4260 |
| 5. Diesel fuel consumed per month (barrels) | 33,730 | 26,000 | 32,740 | 51,600 | 9,500 | 11,900 |

Sources: UMTA, National Urban Mass Transportation Statistics, November 1982 and information from public affairs officials from each system in February 1984.

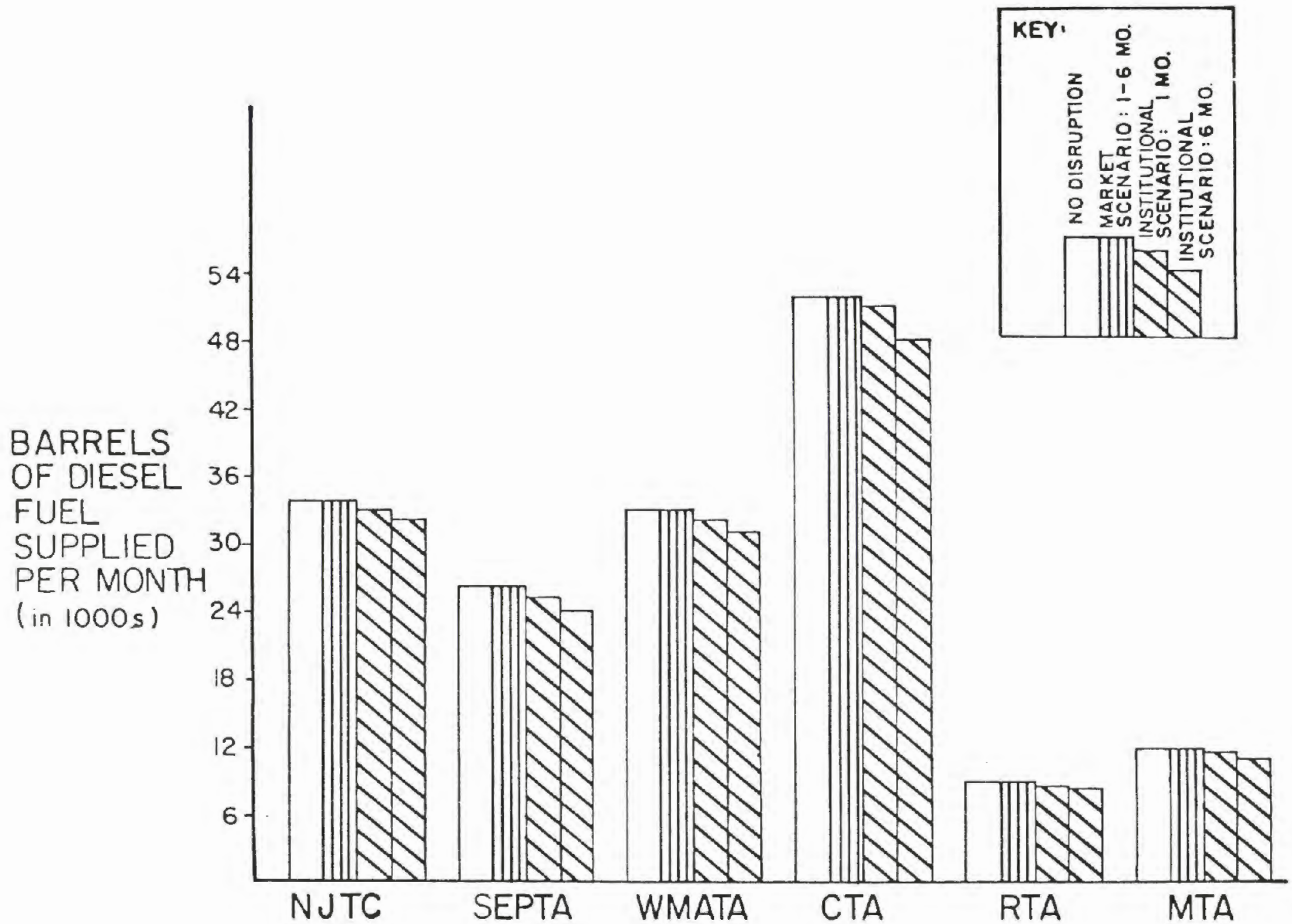


FIGURE 5.1
IMPACT ON MONTHLY DIESEL FUEL SUPPLIED TO SELECTED TRANSIT SYSTEMS FROM MINOR DISRUPTIONS: AFTER ONE AND SIX MONTHS

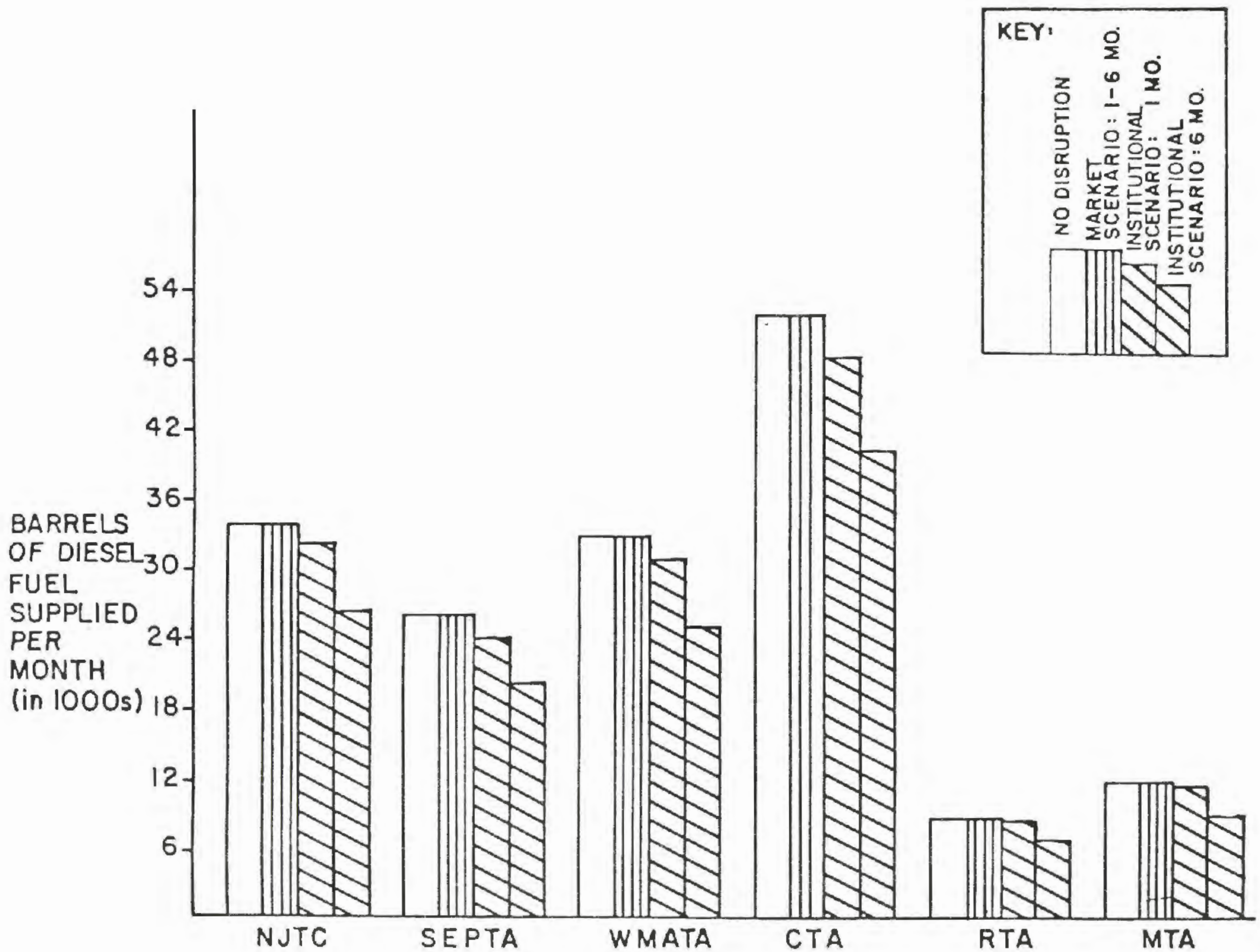


FIGURE 5.2
IMPACT ON MONTHLY DIESEL FUEL SUPPLIED TO SELECTED TRANSIT SYSTEMS FROM MODERATE DISRUPTIONS: AFTER ONE AND SIX MONTHS

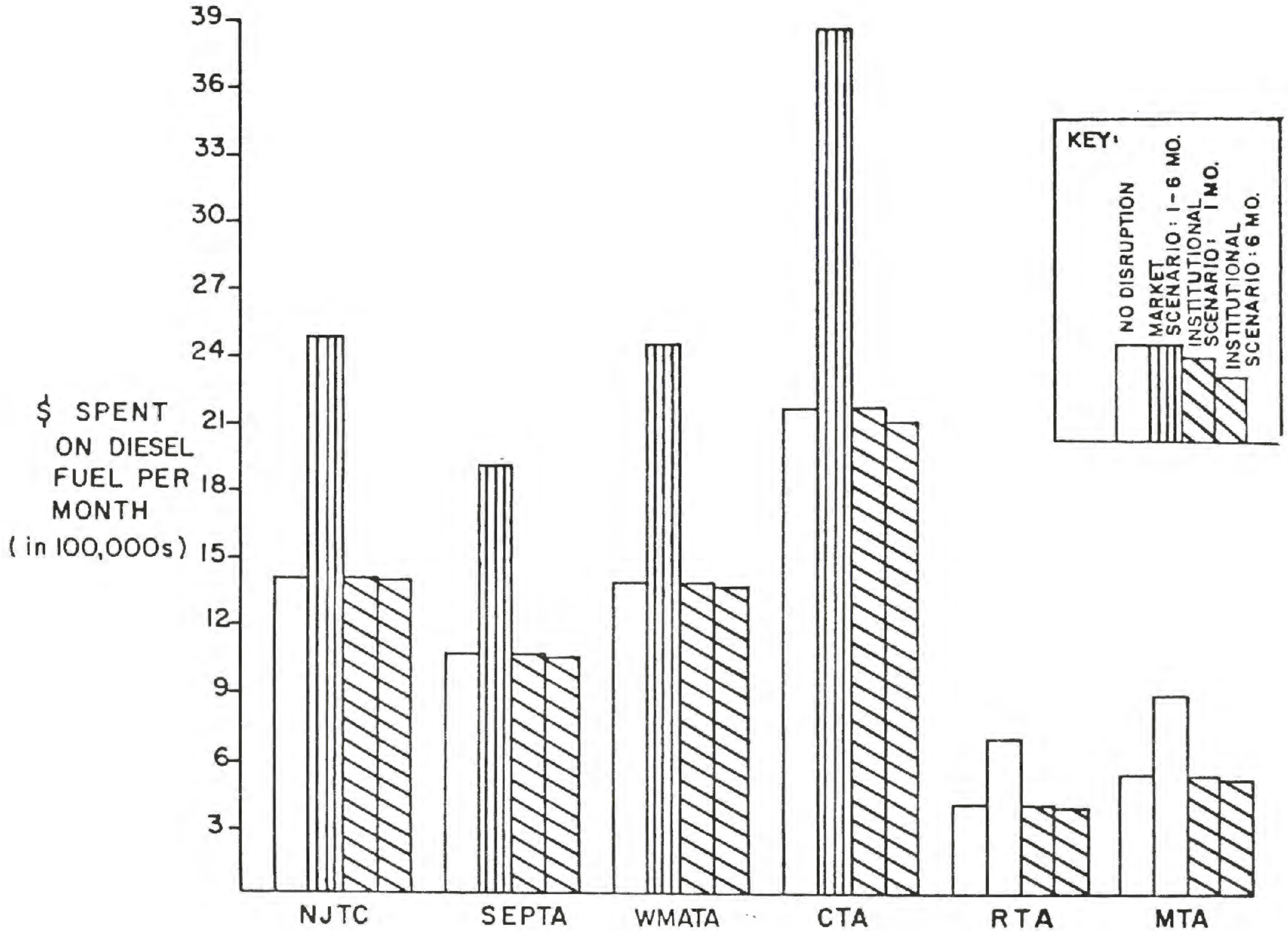


FIGURE 5.3
IMPACT ON MONTHLY DIESEL FUEL COSTS OF SELECTED TRANSIT SYSTEMS FROM MINOR DISRUPTIONS: AFTER ONE AND SIX MONTHS

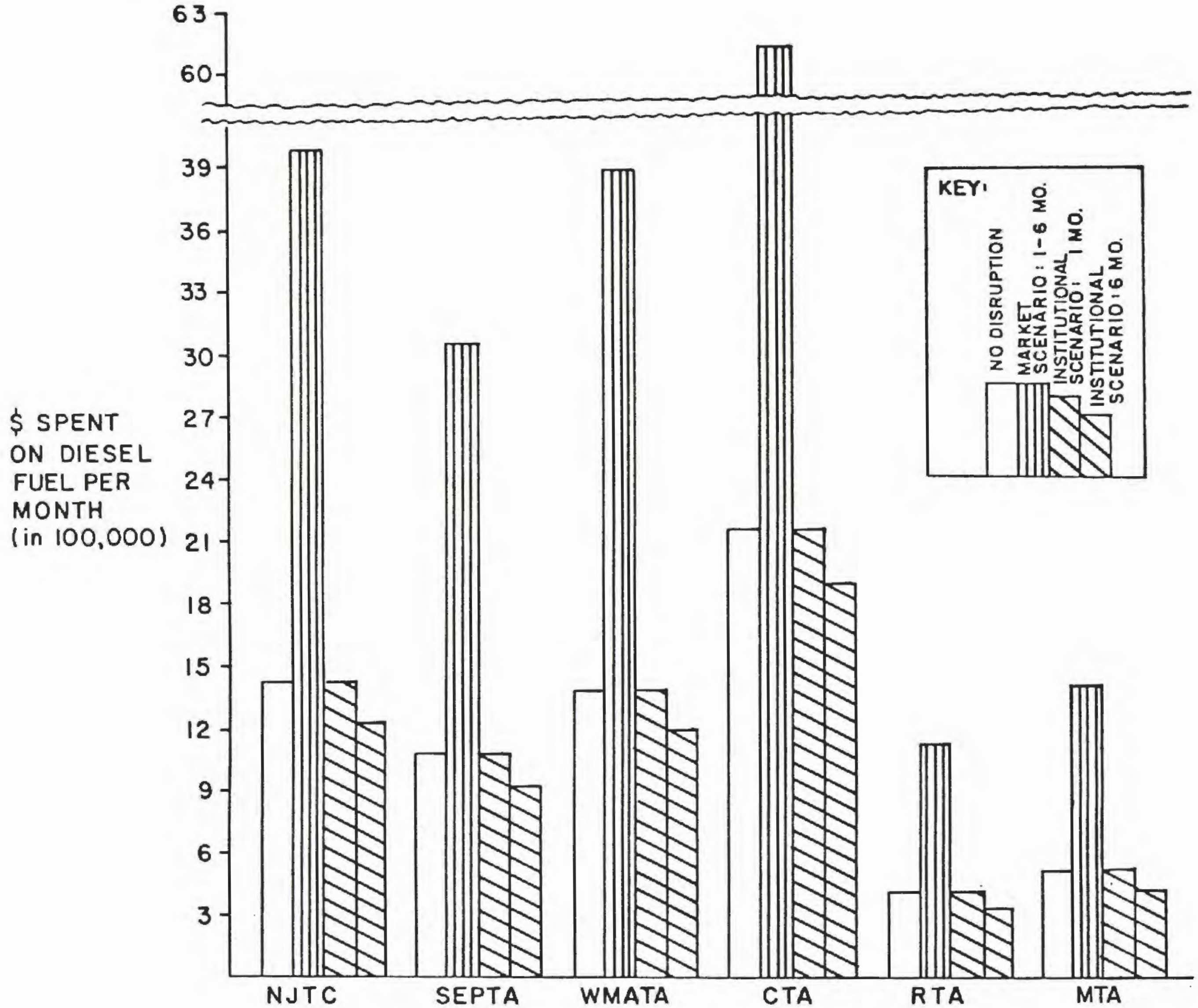


FIGURE 5.4
IMPACT ON MONTHLY DIESEL FUEL COSTS OF SELECTED TRANSIT SYSTEMS FROM MODERATE DISRUPTIONS: AFTER ONE AND SIX MONTHS

If institutional factors intercede, however, allocation of transit fuel supplies is likely. After the first month, transit systems are allocated supplies due to increased inventory demand (in the case of the minor disruption, a negligible reduction occurs). After two months, however, suppliers allocate on the basis of increased inventory demand and world production losses. [Each transit system is assumed to experience a similar allocation fraction. This is a reasonable assumption based on the well-developed system of crude oil and oil product trading existing in the U.S., which regularly moves the nation's internal supply-demand conditions toward equilibrium. Chapter 2 discusses this point in somewhat more detail. Prior to reaching equilibrium, however, allocation fractions might differ and some transit systems might be worse off than others. For example, East Coast Systems (i.e., WMATA, SEPTA and NJTL) might briefly face larger allocation fractions than the Houston MTA because of the greater reliance on imported oil in the East Coast vs. Soutwest region.] By six months, the allocation system, in general, has been finalized under the minor disruption. In the moderate disruption, however, inventory demand continues to grow up until the disruption ends so that the allocation fraction increases beyond six months, although the bulk of the supply reduction occurs between month two and six (see Table 5.2). The largest decrease in actual supplies occurs in the larger systems; for example, the CTA in Chicago loses over 3600 barrels of diesel fuel monthly in the minor disruption after the second month, more than the losses experienced by SEPTA (Philadelphia), RTA (suburban Chicago) and MTA (Houston) combined (although the percentage losses are equal among the systems).

In the moderate disruption, CTA is allocated by the sixth month, nearly 13,500 barrels of diesel fuel less than it received prior to the disruption. That loss represents more fuel than is necessary to operate the entire RTA or MTA systems.

Price impacts explain why supply conditions are so different in the market vs. institutional scenarios. Monthly fuel costs for transit systems under marketplace conditions rise dramatically by the first month (and remain at that level throughout the disruption), as Figures 5.3 and 5.4 show. (These figures again assume that base diesel fuel costs are $1 per gallon. This assumption is not related to the degree of fuel cost increases.) The increases are dramatic and traumatic, particularly for these types of consumers whose contingency budget funds available for possible fuel price increases during the year are on the order of 10-20 percent over current prices.

In the institutional setting however, prices remain unchanged after the first month and then only slowly increase throughout the disrupton period (and beyond its cessation also).

Some of the impacts shown in Figures 5.1 through 5.4 could be altered somewhat by conditions specific to some of these systems. For instance, because of its current reliance on short term contracts, RTA could possibly face very severe shortages, larger than typical allocation fractions. On the other hand, if WMATA were to reinstate a price-fixed contract prior to a disruption, it could withstand all associated price changes.

### 5.3.3 Budgetary Impacts

The budgetary impacts of these supply/price changes are significantly different under the market and institutional scenarios. Figure 5.5 shows that under the market scenario the entire annual (pre-disruption) diesel fuel budget projected by transit systems will be spent at a much faster pace under disruption conditions (and assuming that diesel fuel consumption remains at pre-disruption levels). In a minor disruption, the year's fuel budget will be exhausted in slightly over half a year. In a moderate disruption, the same amount will be spent in slightly more than a third of a year.

Under the institutional scenario, the combined effect of lower fuel consumption levels and significantly lower price increases results in the opposite effect: only 98 percent of the annual fuel budget would be spent at the end of the year-long minor disruption; only 91 percent of that budget would be spent after the year-long moderate disruption.

### 5.3.4 Service Impacts

Bus service provided by transit systems is defined here as vehicle-miles travelled (VMT). Table 5.4 indicated that on a monthly basis, VMT by these six selected transit systems varied between RTA's 1.4 million and NJTC's 9.3 million. On a per-bus basis however (and counting only those buses regularly in service), monthly VMT is somewhat closer. The relatively high per-bus VMT recorded in the NJTC and MTA systems reflect a significant number of long, regional routes.

The impacts that disruptions will have on VMT will be a consequence of fuel or money shortages. In the market scenario, fuel will be available to transit systems, but as Figures 5.3 and 5.4 indicate, at a very high cost. Transit systems will probably need to conserve their fuel budget, cutting back on consumption and therefore VMT. In the institutional scenario, VMT cutbacks will be in direct proportion to the loss in fuel through dealer allocation.

These impacts are defined in Figures 5.6 through 5.9 and Tables 5.5 and 5.6. (Appendix B shows the results of Figures 5.6 through 5.9 in tabular form. The derivation of Tables 5.5 and 5.6 are in Appendix C.) The market scenario is dealt with first. Figure 5.6 and 5.8 show the extreme reaction of transit systems under market conditions: reducing fuel consumption and therefore VMT to the point where pre-disruption monthly fuel costs are maintained. As shown, the service consequences would be dramatic. However, transit systems would not react in such a way. Rather, they would reduce total operating costs as a means of maintaining total pre-disruption costs. Under that mode of behavior, VMT reduction would be less than that shown in Figures 5.6 and 5.8. The actual VMT reductions can be translated into something more concrete: equivalent buses which would have to be removed from service in order to maintain pre-disruption costs during

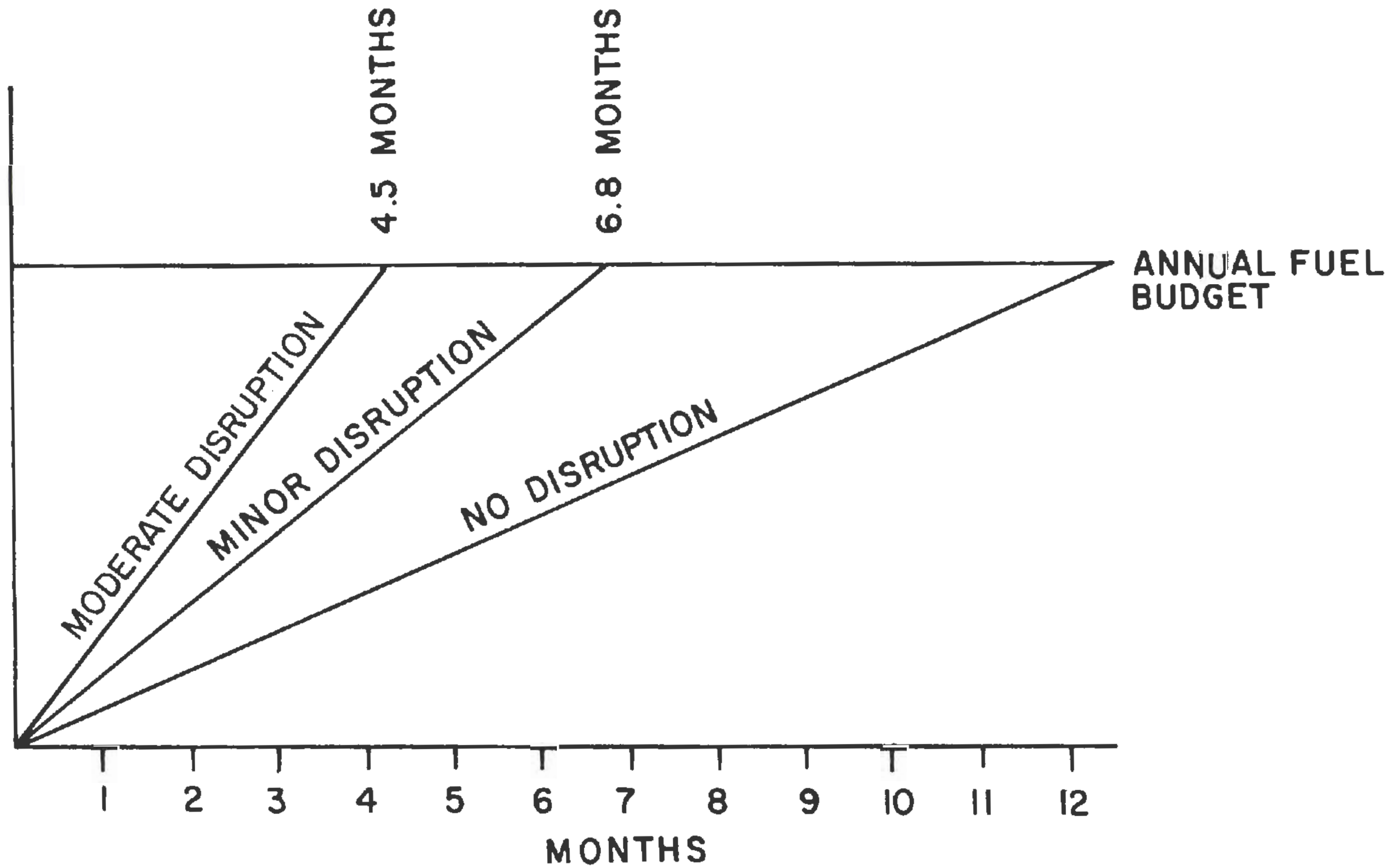


FIGURE 5.5
POINT OF TIME WHERE CURRENT ANNUAL FUEL BUDGET WILL BE EXHAUSTED, ASSUMING CURRENT CONSUMPTION, UNDER THE MARKET SCENARIO

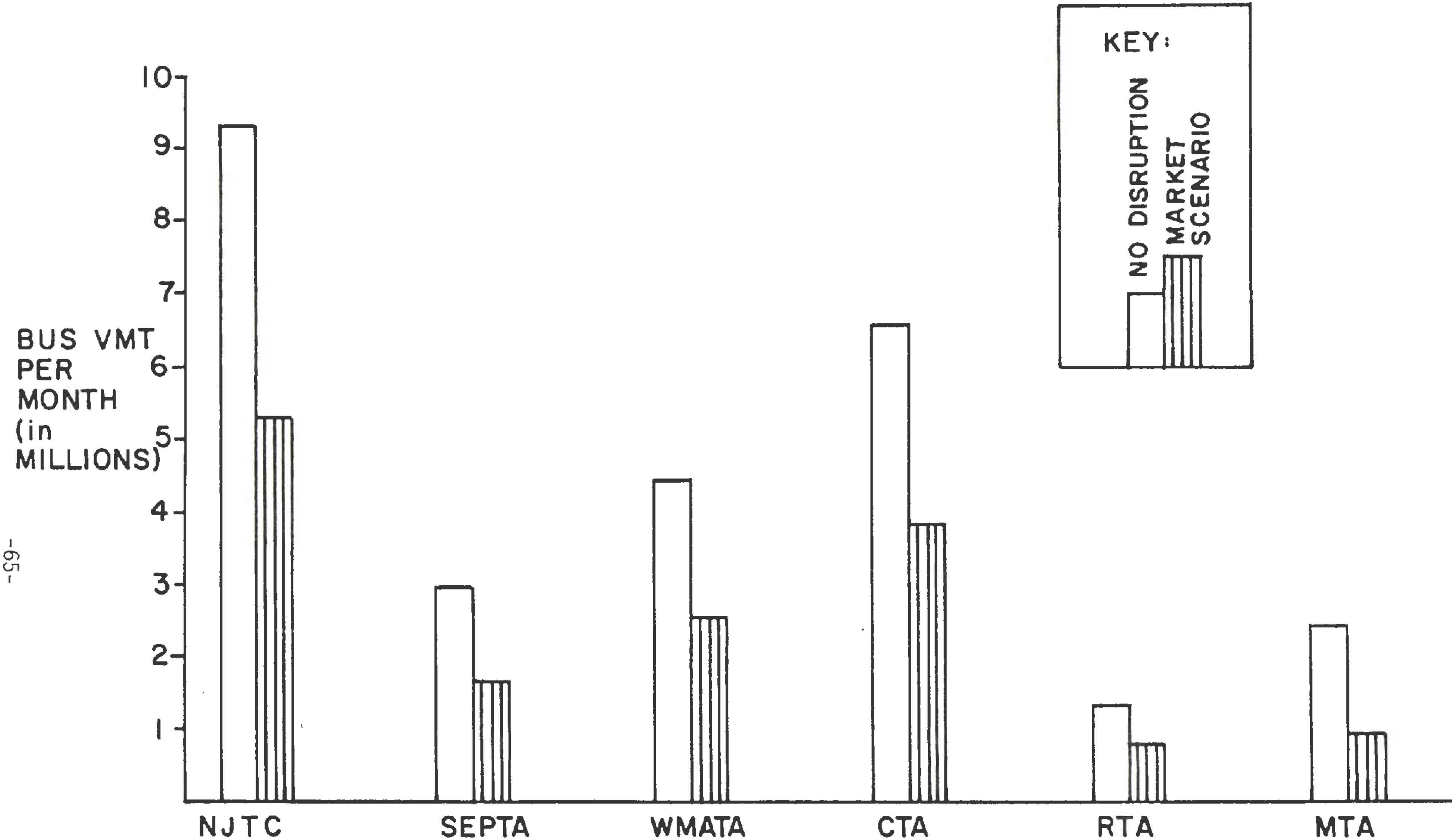




FIGURE 5.6
IMPACT ON MONTHLY BUS VMT BY SELECTED TRANSIT SYSTEMS FROM MAINTAINING PRE-DISRUPTION FUEL COSTS DURING MINOR DISRUPTION

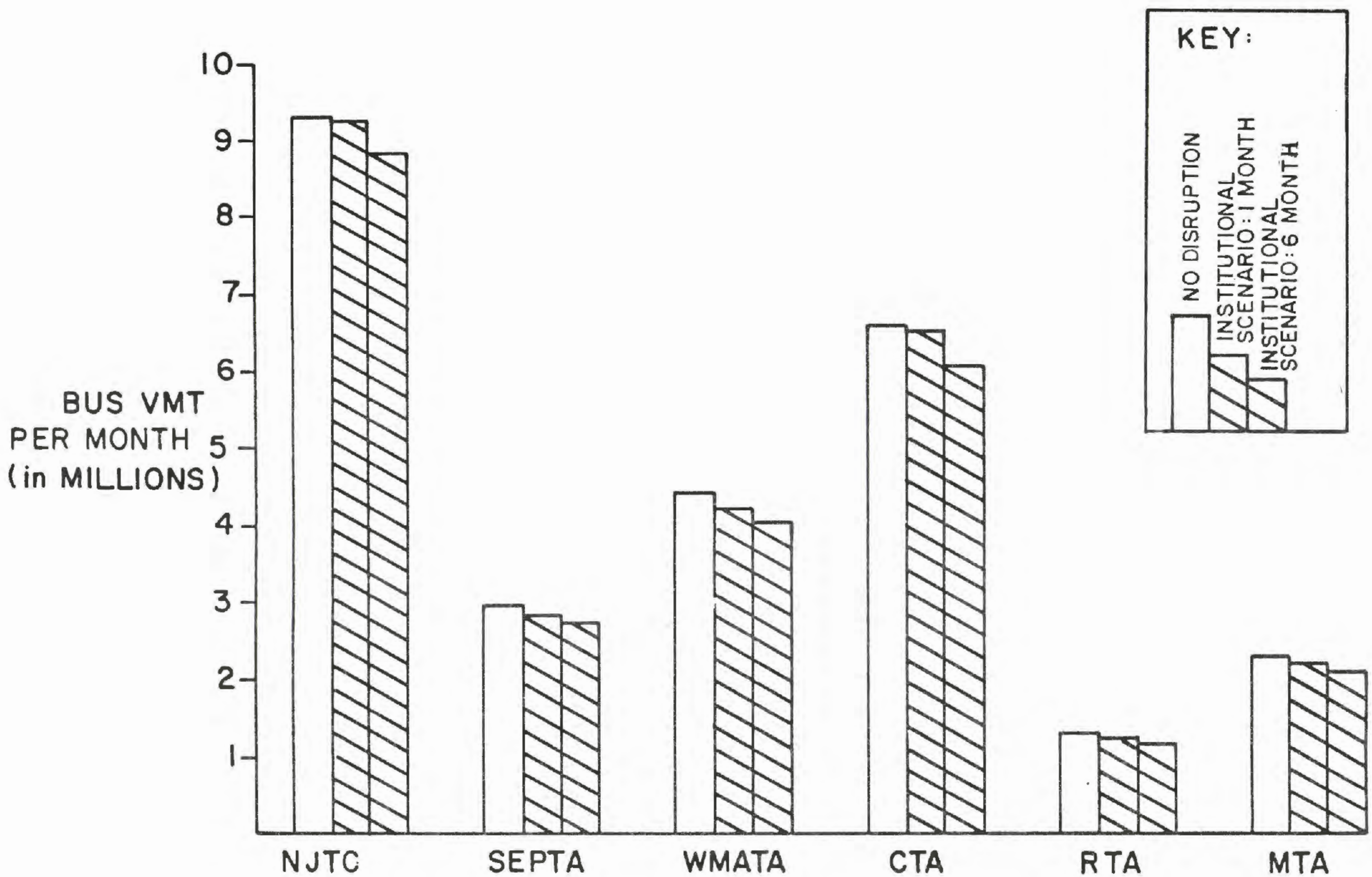


FIGURE 5.7
IMPACT ON MONTHLY BUS VMT BY SELECTED TRANSIT SYSTEMS FROM MINOR DISRUPTION: AFTER ONE MONTH AND SIX MONTHS

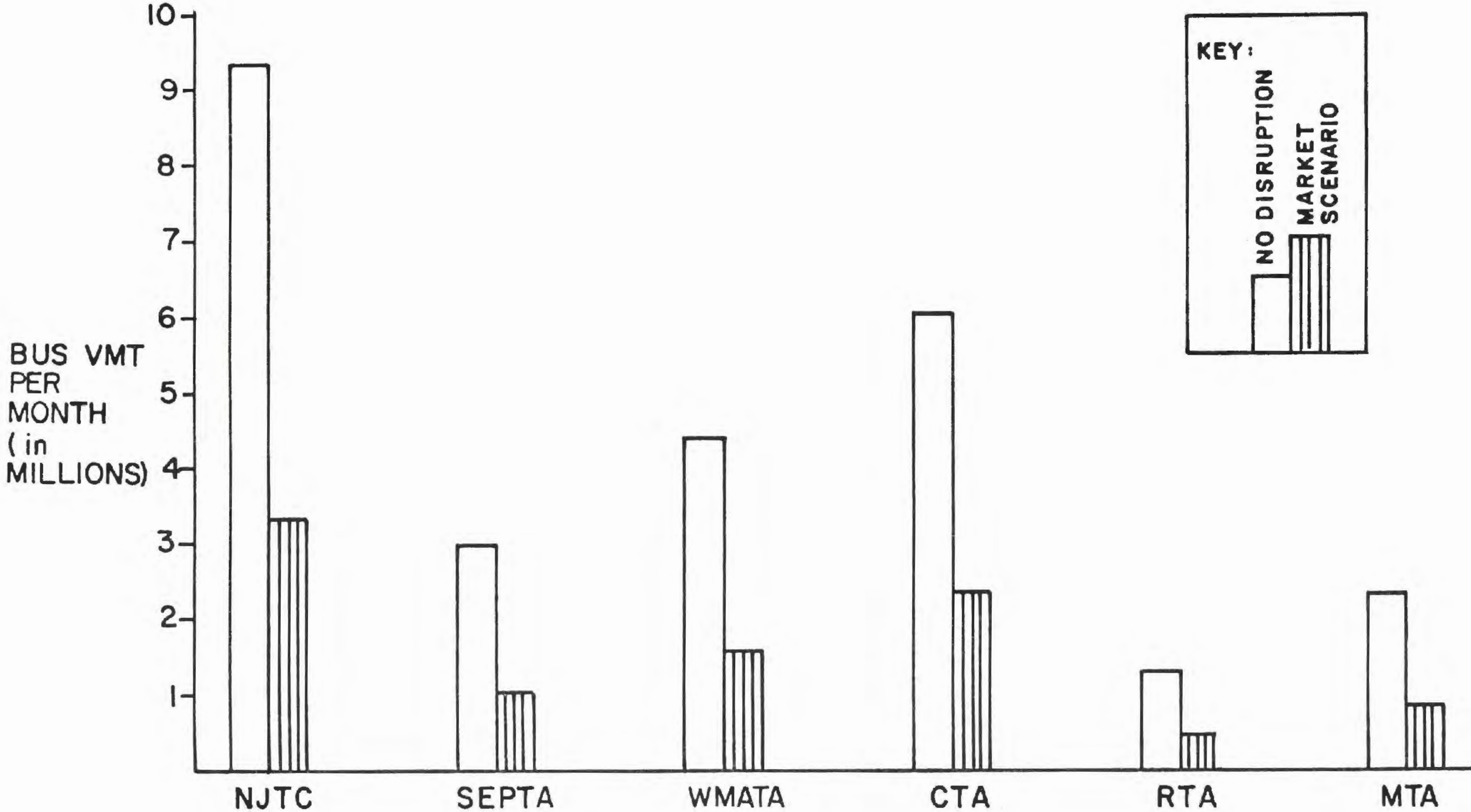


FIGURE 5.8
IMPACT ON MONTHLY BUS VMT BY SELETED TRANSIT SYSTEMS FROM MAINTAINING PRE-DISRUPTION FUEL COSTS DURING MODERATE DISRUPTION

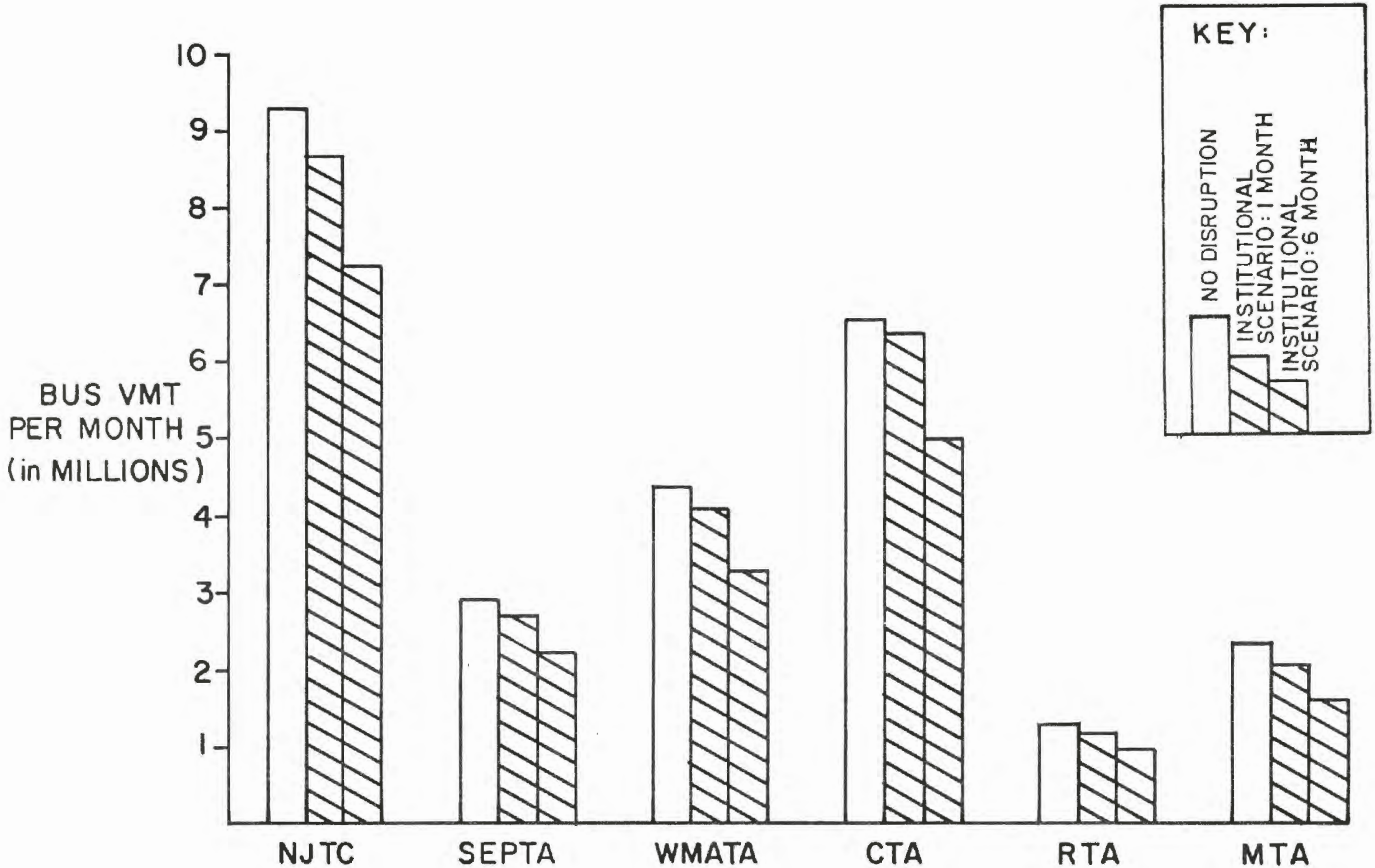


FIGURE 5.9
IMPACT ON MONTHLY BUS VMT BY SELECTED TRANSIT SYSTEMS FROM MODERATE DISRUPTION: AFTER ONE AND SIX MONTHS

## TABLE 5.5

## NUMBER OF EQUIVALENT BUSES TAKEN OUT OF SERVICE UNDER MARKET SCENARIO

| System | Minor Disruption: # | % of Fleet | Moderate Disruption: # | % of Fleet |
|---|---|---|---|---|
| NJTC | 133 | 7 | 315 | 18 |
| SEPTA | 139 | 12 | 344 | 29 |
| WMATA | 106 | 7 | 252 | 17 |
| CTA | 130 | 7 | 310 | 16 |
| RTA | 36 | 8 | 88 | 18 |
| MTA | 41 | 8 | 98 | 18 |

See Appendix C for derivation

## TABLE 5.6

## NUMBER OF EQUIVALENT BUSES TAKEN OUT OF SERVICE UNDER INSTITUTIONAL SCENARIO[1]

| System | Minor Disruption: # | % of Fleet | Moderate Disruption: # | % of Fleet |
|---|---|---|---|---|
| NJTC | 97 | 5 | 409 | 23 |
| SEPTA | 83 | 7 | 289 | 24 |
| WMATA | 90 | 6 | 353 | 23 |
| CTA | 138 | 7 | 468 | 24 |
| RTA | 34 | 7 | 113 | 24 |
| MTA | 37 | 7 | 130 | 24 |

[1] After six months.
See Appendix C for derivation

market scenarios.* Using estimates of operating costs per bus in service (see Appendix C), Table 5.5 shows that in order to maintain pre-disruption costs, a significant level of service would have to be cut (but far less devastating than the more isolated picture which Figures 5.6 and 5.8 show).

The service impacts under an institutional scenario are roughly similar. If institutional conditions prevail, VMT would drop simply as a result of fuel unavailability (see Figures 5.7 and 5.9). Table 5.6 shows the level of equivalent buses taken out of service.

### 5.3.5 Service Expansion Impacts

Few transit systems increased service during prior oil supply disruptions (6, 7). Of the six case study transit systems presented here, only WMATA increased its service in 1979, although only after much delay and not to any great extent. Still, transit service expansion remains a feasible policy consideration, as both a means of easing peak capacity problems (which arose in past disruptions and which are likely to arise again) and as a means of restoring some portion of the mobility lost by reduced auto use. Earlier chapters pointed out that there is no generally accepted level of service expansion which transit systems are considering for future disruptions: nearly all systems resist formalizing this particular component into current contingency planning. For the purposes of this work however, some reasonable service expansion goals have been formulated. These are:

- During a minor disruption, transit systems may have as an objective a five percent increase in VMT;
- During a moderate disruption, transit systems may have as an objective a 10 percent increase in VMT.

These are reasonable maximum VMT increase limits, because transit systems will first exhaust other methods to increase capacity (e.g., allow more crowding, encourage variable work hours and off-peak transit use) prior to adopting strategies that incease VMT (10).

If institutional conditions prevail either during a minor or moderate disruption, the objectives simply will not be met: transit systems will not have enough fuel available to maintain current VMT let alone increase VMT. Under the market scenario, however, fuel will be available such that the objectives can be met, but at a significant cost. That cost would have to be recovered by such market actions as temporary or other fare increases. Figures 5.10 and 5.11 indicate what that cost will be. (Appendix B shows this information in tabular form. Comparing these figures to Figure 5.3 and 5.4, however, shows that the added costs are not substantially above those experienced at the current VMT levels: in a minor disruption, monthly costs would generally be 6 percent more if VMT were increased 5 percent; in a moderate disruption, monthly costs would generally be 11 percent higher if VMT were also increased 10 percent.

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* The options for reducing costs (or VMT) are boundless (e.g., cut all buses an equivalent amount, cut some more than others, remove buses from service, a combination of the above, etc.) and dependent upon factors specific to individual systems. Equivalent buses removed from service is a comparison tool only, not meant as a forecast or recommendation of how to cope with the need to reduce costs or VMT. Whatever option is chosen, however, there is one universal impact: services will degrade.

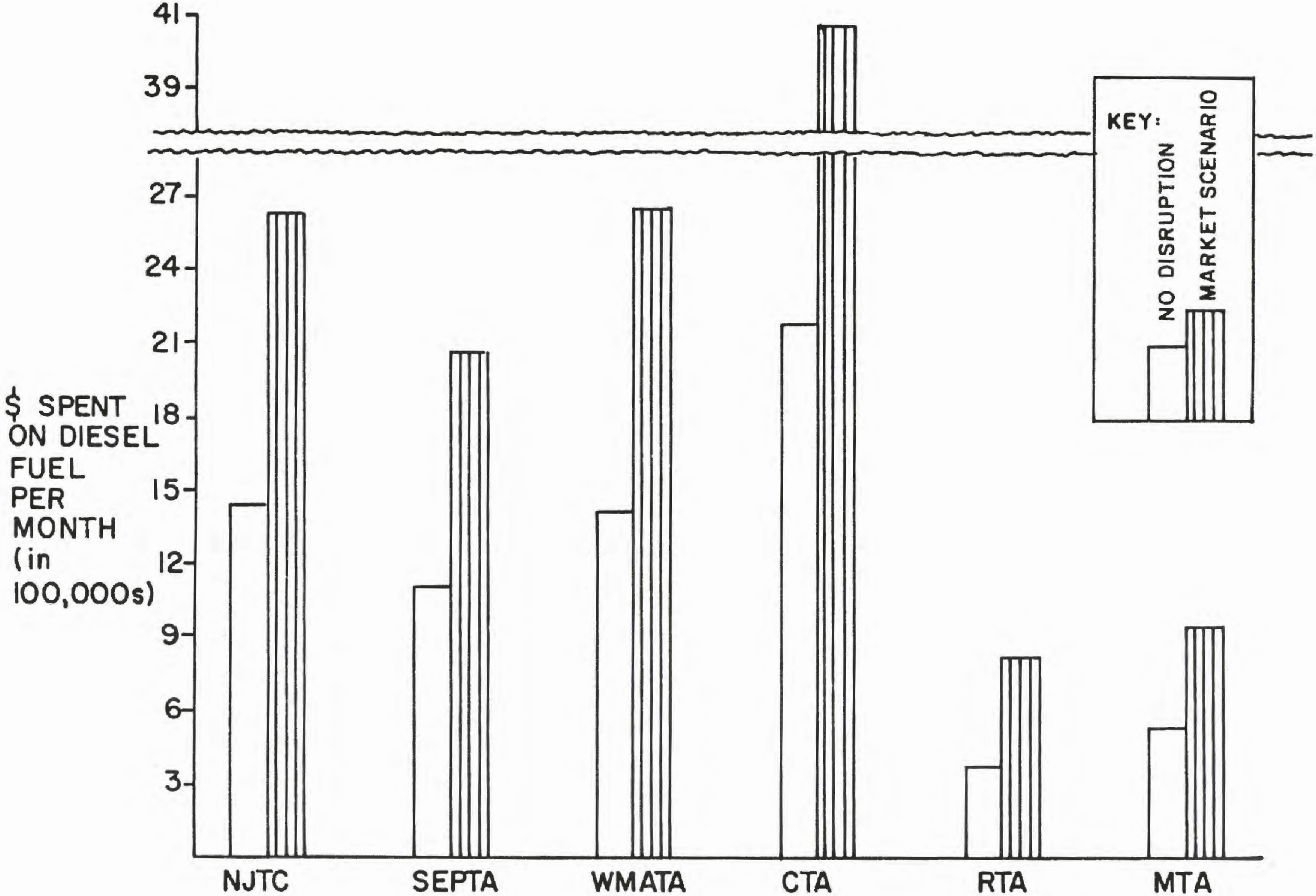


FIGURE 5.10
IMPACT ON MONTHLY DIESEL FUEL COSTS OF SELECTED TRANSIT SYSTEMS AS A RESULT OF 5 PERCENT VMT INCREASE DURING A MINOR DISRUPTION

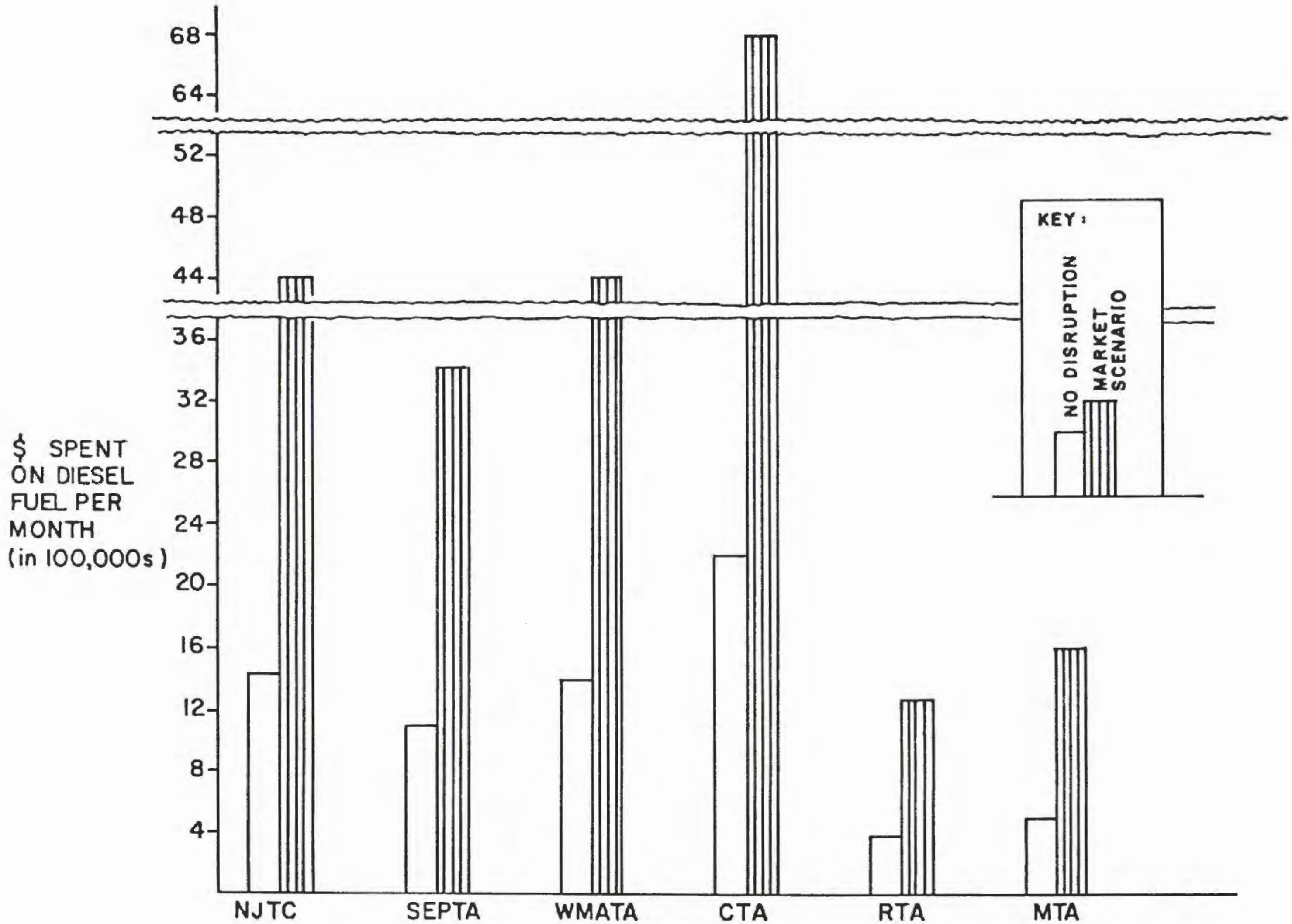


FIGURE 5.11
IMPACT ON MONTHLY DIESEL FUEL COSTS OF SELECTED TRANSIT SYSTEMS AS A RESULT OF 10 PERCENT VMT INCREASE DURING A MODERATE DISRUPTION

The resulting effect on the annual fuel budget is shown in Figure 5.12. When comparing with Figure 5.5, the effect of increased service is that the annual fuel budget (already far inadequate under the market scenario) will be exhausted 1-3 weeks earlier than if current VMT levels were maintained. Whatever increased ridership accrues from increased service is likely to be used to defray other increased operating costs.

## 5.4 Summary of Disruption Impacts

The only certainty is that future oil supply disruptions will affect public transportation systems detrimentally. Beyond that simple conclusion lies a range of impact levels extending from small to extremely severe. The range relates to the potential for either minor or moderate losses in free world oil production, as well as a significant difference in opinion as to whether market forces will or will not prevail during such disruptions. However, the limits of the impacts can be defined, although only within prescribed scenarios of likely oil supply disruptions. These limits are as follows:

- Supply shortages may occur during disruptions, if prices rise slowly. The best forecast is that if such a shortage occurs, all consumers will be allocated the available fuel in a somewhat equitable fashion. The limit of that shortage is not, however, the level of worldwide oil loss, but that loss plus added demand due to price-speculating stockpiling. During moderately sized disruptions, the additional stockpiling can have a major and continually worsening effect on shortages.
- If prices do rise quickly during disruptions, transit systems can be expected to have fuel available for all current (or even expanded) services, but at a substantially higher cost: monthly fuel costs could rise by almost 80 percent from the start during a minor disruption, and by nearly 200 percent during a moderately sized one. In both cases, the budget allotment for fuel for the year would be exhausted in far less time.
- As a consequence of these substantial cost and budget impacts, transit systems could choose instead to reduce their costs by reducing fuel consumption (as most consumers would do). This is not a logical response given the public need, but might be forced within an institutional scenario. At the limit of trying to maintain pre-disruption costs, transit systems would have to cut back the equivalent of around 5-12 percent of their bus fleet during minor disruptions and 16-29 percent during moderate disruptions. Under these choices, the services provided would no longer resemble what is currently accepted as basic public transportation services.
- However if prices do not rise significantly, transit systems will still be required to reduce bus operations by the equivalent of around 7 percent during a minor disruption and 24 percent during a moderately sized one (equal to the level of fuel shortages).
- Service expansion cannot be accomplished when fuel is restrictively allocated, for obvious reasons. When fuel is available but expensive, expansion is possible but unlikely because of the costs involved (although the costs of added vs. current services are marginal and not large).

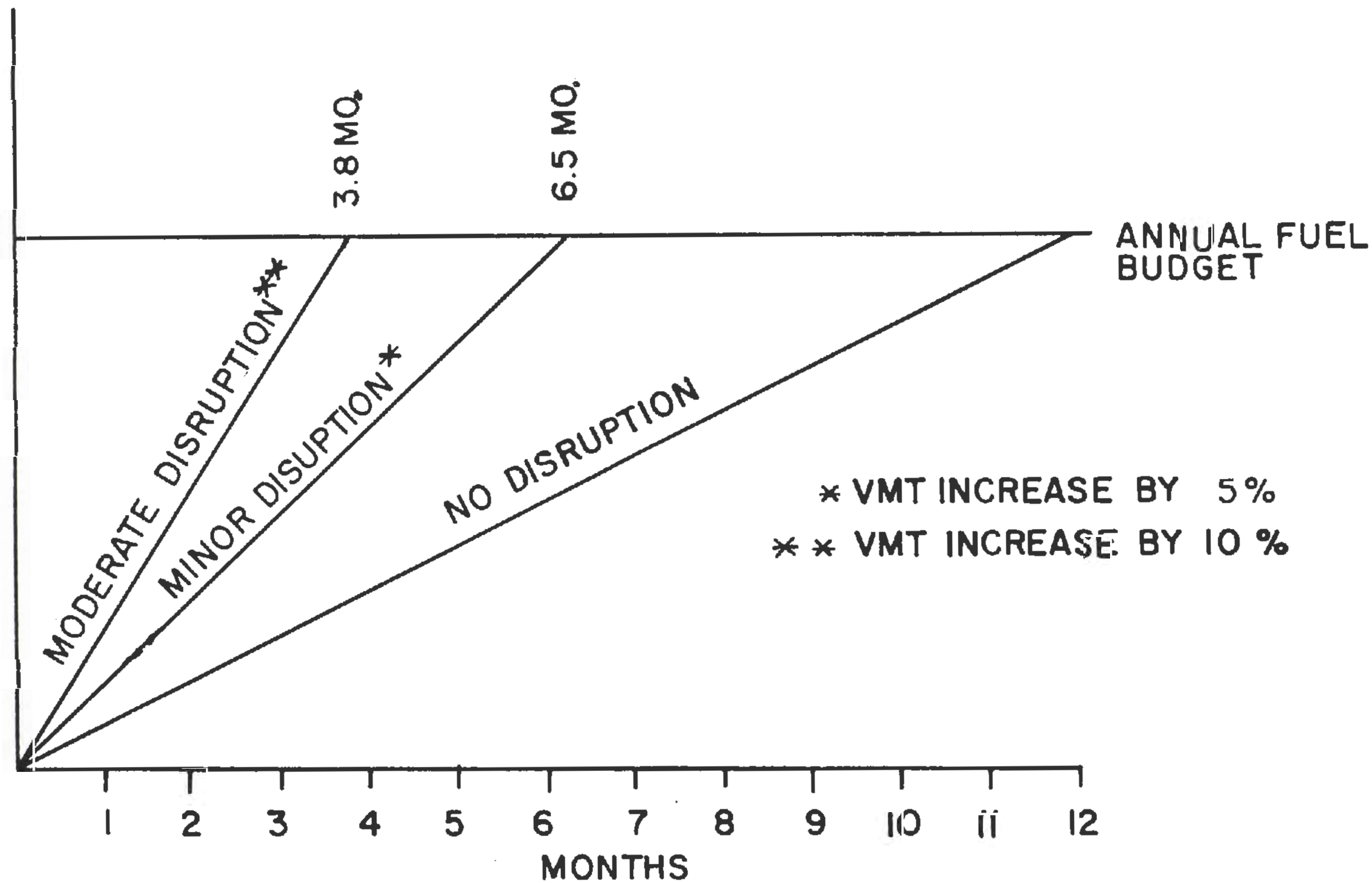


FIGURE 5.12
POINT OF TIME WHERE CURRENT ANNUAL FUEL BUDGET WILL BE EXHAUSTED, ASSUMING INCREASED CONSUMPTION, UNDER THE MARKET SCENARIO

## 5.5 Identifying Alternative Actions to Relieve Disruption Impacts

A finite list of alternatives are proposed here to help relieve the previously identified impacts of supply disruptions. The alternatives represent in themselves only a subset of the any number of possible ways in which transit systems could be assisted during disruptions. The alternatives chosen represent the most currently feasible actions which can be expected to occur, based on a) past experience, b) policies and plans of government agencies, and c) notable proposals by interested parties. The alternatives considered are the following:

1. Continuation of current fuel procurement procedures (Circa 1984).
2. Federally mandated 100 percent allocation of supplies to transit systems.
3. Use of the federally-controlled Strategic Petroleum Researve in a) a general release format or b) a directed sales format.
4. State set-aside fuel allocation to transit systems.
5. New fuel procurement procedures.
6. Emergency assistance measures.

The following sections briefly discusses each of the alternatives listed above, describing their main features.

### 5.5.1 Continuation of Current Fuel Procurement Procedures (Circa 1984)

The fuel procurement process current during the 1983-84 preparation of this document has two main features: the use of contracts to purchase fuel and the storage of fuel for inventory purposes. For the most part transit systems engage in relatively long-term contracts (i.e., either semi-annual or annual with a one time renewal option), which specify fuel characteristics in detail. Price is normally set for a base period, with an upward (and, in fewer cases, downward) adjustment according to an agreed upon posted price scale. The amount of fuel covered by the contract is an estimate, giving transit systems the option of purchasing substantially more or less than the specified amount under the same contractual terms.

Transit systems engage in contractual arrangements, in part, because of government procurement rules for low bid procedures. For this reason, transit systems do not deal directly with the non-contract based spot market (from which about 10 percent of the world's fuel products are purchased). However, a few transit systems deal indirectly with spot market dealers while maintaining contractual arrangements by a) using short-term (one month) vs. long-term contracts or b) deferring contracted purchases in favor of cheaper spot market products.

For the most part, transit systems maintain low inventory levels, generally with no more than a few days to a weeks worth of supply. After the 1979 Iranian supply disruption, a number of systems expressed interest in (and some even implemented) contingency fuel inventories (Seattle Metro's 90-day supply plan was far and away the most ambitious). However, in the interim period of constant supply, economic factors have come to dominate contingency objectives: steady (and then declining) prices and high interest rates have discouraged transit systems from maintaining supplies over and above those required to meet minimum operating needs.

In summary, this alternative is a continuation of the current long-term, price-adjusted contract and minimum inventory procedures which most transit systems adhere to in the normal procurement of diesel fuel supplies.

### 5.5.2. Federally Mandated 100 Percent Allocation of Supplies to Transit Systems

Essentially, this would mean the return of Special Rule No. 9 which existed as a Federal regulation from Spring 1979 to Spring 1981. Public transportation systems would be guaranteed 100 percent of their diesel fuel needs. Under this requirement, the Federal government does not actually transfer fuel products to those transit systems in need, but rather issues certificates to transit systems which allow them to request and receive additional fuel from regular (or even new) suppliers. Basically, the requirement releases oil distributors from what many of them consider to be a contractual commitment (as specified by the Uniform Commercial Code) to distribute shortages equitably and not to favor any customer over another. In point of fact, the relevant section of the Uniform Commerial Code (UCC), Section 2-615, specifies an allocation scheme which is fair and reasonable. Furthermore, judicial interpretation of Section 2-615 specifies that allocation is necessary only if the shortage is objectively unforeseen by supplier and consumer (The UCC deals with contracts in general and shortages of any product type). At least one source states that since oil disruptions are very forseeable events, the allocation requirement does not hold for oil markets, meaning that oil companies could distribute fuel as they see fit (11). Even if assuming that the allocation requirement were to apply to oil markets, there is much to be said for the concept that 100 percent allocation to public transportation systems could be part of a fair and reasonable scheme.

However, a Federal regulation may be a better way to guarantee 100 percent of fuel requirements to transit systems. First, a number of oil distributors would not want to risk UCC related court actions and would automatically allocate in an across-the-board manner. Second, those that accept the opinion that UCC allocation does not apply may be strongly motivated to follow market principles in distributing supplies: selling to the highest bidder. Third, those that accept the applicability of UCC allocation but see more flexiblity in the fair and reasonable precept will be hard pressed to meet 100 percent of transit demand when other so-called essential users (e.g., other government services, farmers, truckers moving perishable goods) also put in their claims for preferential treatment. Therefore, in order to a) relieve the burden of decisionmaking from oil distributors, b) avoid delaying court procedures and c) assure that transit systems are treated equitably on a nationwide basis, a Federal allocation regulation is a better method than the free market if one wanted to guarantee 100 percent fuel requirements for transit sytems during a disruption.

### 5.5.3 Use of the Strategic Petroleum Reserve

There exists a whole area of uncertainty related to the possible use of the Strategic Petroleum Reserve (SPR). As Chapter 4 pointed out, two major questions persist: when to use the SPR and how to use it. Leaving aside at this point the question of when to use the SPR (i.e., during a minor, moderate or major disruption), the question of how to use the SPR boils down to two sub-areas: how much should be released (and at what rate), and who should get it. In terms of how much should be released and at what rate, a full range of options exist between a) a maximum drawdown rate (see Figure 4.2) at the start of a disruption continuing until SPR fuel is depleted or nearly depleted to b) a low drawdown rate continuted over the course of the disruption (12). In the first extreme, the full effects of a disruption would be postponed for many months (e.g., up to nine months, given the moderate disruption described earlier in this chapter); in the latter extreme, the effects of a disruption would be lessened only slightly. The uncertainty over how much and at what rate to release the SPR is a purely political uncertainty completely within the purview of the Federal government. It is, therefore, not an unreasonable assumption to make, for the purposes of this work, that given a minor or moderate disruption, if the decision is made to use the SPR, the drawdown plan will more reflect concerns about the unpredictability of disruption length, severity and repetitiveness rather than the concerns of harm to the immediate economy. In other words, a conservative, relatively low drawndown rate will be utilized (at least throughout the next disruption, if not the one or ones following that).

As concerns who should get fuel from the SPR, this is for the most part already determined. At least 90 percent will be sold (in set allotments) by monthly auction to the highest bidders. If a less market oriented President were to be in power, the scheme might be altered to an allocation distribution to U.S. refiners. If more market-oriented concepts emerged, the auction might be converted into an options market. In any of these schemes (both of which were discussed in Chapter 4), the objective is to distribute fuel where it most needed, whether need is determined by the market or by government fiat.

Under the present plan, however, up to 10 percent of the available SPR could be sold in directed sales to buyers selected at the discretion of the Federal government. (Alternate plans for distributing the bulk of SPR fuel also could have similar directed sales or special-case allocation provisions.) This provision could be utilized for the benefit of transit systems. The Federal government could directly sell up to 10 percent of SPR released fuel to transit systems. They would then have to in turn sell it to their suppliers for conversion into diesel fuel to be used exclusively by transit systems, because the SPR contains only crude oil reserves. (If the refiner-allocation system emerged at some later time as the SPR distribution system, the Federal government could direct up to 10 percent of released supply to certain refiners for the specific use by transit systems. Under the options alternative, up to 10 percent of the options available could be sold to transit systems.)

In summary, the SPR alternative would be used primarily to direct most of what is likely to be a limited drawdown of SPR supplies to those parties which the market (or the Federal government) determines to be the most needy. However, a small amount of available SPR fuel could be directly sold to meet the needs of the nation's transit systems.

### 5.5.4 State Set-Aside Fuel Allocation to Transit Systems

In the absence of any current Federal program, about 25 states have created or are actively considering reinstating such programs. Recently, a conference of government and oil market officials agreed that a state set-aside program could be a useful tool to respond to hardship cases during oil disruptions (13). Essentially, the state government would be allowed to claim for itself a certain percent of various fuels being sold in the state for the first time (i.e., to eliminate double counting of fuels sold within the state first by refiners to distributors and then by distributors to consumers). The percentage is likely to vary between 2 percent (as suggested by oil company officials) and 5 percent (as a few states have designated) (14). The fuels will vary also but will likely include diesel fuel, either as a separately designated fuel or as one of a number of designated middle distillate fuels. As with the Federal allocation alternative, under the state set-aside program no fuel actually is transferred physically to the state. Instead, on a monthly basis, the state grants certificates to consumers allowing them to purchase a specified additional amount of fuel from their current (or even a new) supplier. The total amount of fuel designated by such certificates is limited to the specified set-aside percentage.

A number of oil companies, and some states at well, have called for a standby Federal state set-aside program (similar to that which existed in the 1970s) in order to standardize set-aside percentages, fuels, end users, etc. (15). If this occurred, the only difference from the current situation would be the existence of one uniform set-aside program for 50 states rather than the variety now in place.

Under active set-aside programs of the past, states utilized a federally-mandated priority list of who should receive the fuel. Under current programs, each state sets its own criteria for hardship needs or priority users. States could easily designate transit systems as the highest priority, capable of receiving all their needs within the constraints of the set-aside percent. If a Federal state set-aside program were created, it too could designate transit systems as the highest priority users, eligible to receive 100 percent of their needs from the available set-aside amount.

In summary, this alternative would be implemented by the states to provide all required fuel needs of transit systems by allocating a portion of the statewide pool of available diesel fuel being sold in a given month.

### 5.5.5 New Fuel Procurement Procedures

This alternative involves the employment of innovative fuel procurement procedures. Such procedures would have to be implemented during a period of stable supply in order to have any effectiveness during a disruption. While there is room for improvement and innovation in many areas of fuel procurement, this work is concerned with three particular areas:

1. Purchase of fuel through cooperative agreements;

2. Entry in the heating oil futures market;

3. Building a reasonable contingency inventory, modified by economic conditions.

These are described below.

1. Cooperative Fuel Purchasing. The National Institute of Government Purchasng refers to this is as Joint Bid Intergovernmental Cooperative Purchasing whereby two or more government entities buy a good or service from the same supplier as a result of a single request for competitive sealed bids (16). The concept is well developed in terms of various products, but only recently have applications arisen in the area of joint fuel purchases or involving transit systems. WMATA is the major example, where beginning in 1981 it began acting as the diesel fuel purchasing agent for other government agencies in the Washington, D.C. area. While 75 percent of the diesel fuel purchased is used by WMATA, some smaller neighboring transit systems and government agencies were able to pool their diesel fuel needs and accrue the benefits of joint purchasing (17). Elsewhere, Dade County, Florida just began cooperative diesel fuel and gasoline purchasing in 1983, with the County (which runs the transit system) joining with nearly 30 municipalities in a joint procurement (18). Other than these cases, there are very few examples of joint fuel purchasing by government [although cooperative heating oil purchasing by homeowners is increasing and pooled purchasing of other items by transit systems is increasing (e.g., joint purchase of 1,000 buses by 16 Pennsylvania transit systems in 1982) (19)].

The obvious advantages of cooperative fuel purchasing are a) better base contract prices which can be obtained from large quantity purchasers and b) a reduction in administrative costs for most participants due to the designation of a single purchasing agent. There are also some shortcomings, including a) a loss in local control and ability to monitor purchasing activities and b) difficulty in obtaining special treatment and/or specific fuel characteristics different from other cooperative members. But there are other benefits to be derived from cooperative fuel purchasing arrangements which are less obvious and which pertain to the subject of this work. They include:

a. A capability, through the leverage of large quantities purchased, to obtain better contractual terms, including price de-escalation clauses, discounts on base prices and more favorable posted-price indices;

b. The incentive and the resources to create an innovative fuel purchasing department, one which can investigate and possibly participate in such ventures as a) during periods of constant supply, the futures market and even the spot market, and b) during oil disruptions, the SPR auction and/or SPR options auction;

c. The cooperative experience among agencies, which can lead to other related joint ventures, including joint contingency fuel inventories, joint contingency fuel lending and even joint contingency fuel budgets.

There are a number of possible markets for cooperative fuel purchasing, including a) small transit systems in one particular region (where a cooperative arrangement could have results similar to these in Suburban Chicago, where the numerous transit systems joined together under the RTA umbrella and created an innovative fuel purchasing contract); b) small transit systems with nearby larger systems; c) transit systems with other nearby government agencies; and d) transit systems and government agencies located over a larger regional, or statewide area.

2. Entering the Futures Market. As Chapter 3 noted, the major reasons why transit systems have not entered the heating oil futures market are:

- Lack of understanding and wariness of such extra-contractual arrangements by transit systems (and relevant supervisory state or local governments);
- Little incentive to engage in fuel price protection;
- Transit system too small for independent participation;

In other words, the problems do not pertain to the futures market itself but to the level of understanding, incentives and size of transit systems themselves. Therefore, it is conceivable that through a) better understanding of the futures market, b) an increasing awareness of the volatility of oil prices and c) the sophistication and leverage which cooperative fuel agreements can create, the futures market will becomes a more attractive venture for transit systems. The education process has already begun, with a series of UMTA reports on transportation energy contingency planning under deregulation (20) [one of which deals directly with the futures market (21)]. The possibilities and benefits of cooperative purchasing have already been discussed.

Since the futures market reflects uncertainty over supply and demand conditions in the near term (i.e., up to one year from the date of the contract), it has the potential to be of assistance during supply disruptions (along with being of assistance during periods when supply is constant but demand fluctuates). First, and foremost, there are monetary benefits to be earned when disruption-induced price increases occur and buyers are holding less expensive futures contracts. These earnings can be used to offset new disruption prices. Secondly, there is always the possibility that with a fixed-supply futures contract in hand, buyers could take delivery of the heating oil (or, more likely, a similar diesel fuel product obtained through a trade with the seller) and supplement any shortages in regular fuel supplies.

3. Building a Reasonable and Responsive Fuel Inventory - As defined here, a reasonable contingency fuel inventory is one which is expected to provide supplemental support in the event of allocated or very expensive supplies during a minor or moderate disruption. The inventory would not be capable of substituting for a complete shutoff of deliveries (which is not an expected outcome of these disruptions in any event), nor could it be used to substitute completely for more expensive fuel delivered during a disruption. Having stated the bounds of what it can't provide for, two questions need to be answered in order to determine what a reasonable contingency inventory *can* provide for. First, should a reasonable contingency inventory consider price or supply protection as the key objective, since either could occur under a disruption (as put forth in market vs. institutional scenarios)? This work chooses supply protection as the key objective for a very basic reason: it is simply easier to determine what level of supply protection is universally reasonable than what level of price protection is universally reasonable. Under the institutional scenarios, a reasonable contingency inventory should provide for 7 percent of a system's daily supply needs during a minor disruption or 25 percent of its supply needs during a moderate disruption throughout the year. This translates into a 25-day and a 90-day inventory, respectively. Both objectives would meet a system's current fuel needs even while a disruption

was ongoing for a year. If instead the market scenarios emerged, how can it be determined what level of price protection is reasonable? As earlier stated, 100 percent price protection is unreasonable, but is 90 percent reasonable? 75 percent? 50 percent? There is no universal answer and therefore the supply protection objective is chosen instead. [Obviously an individual transit system could decide that price protection is more important and that a given percent of protection is reasonable. It could then formulate inventory size based on those criteria. For instance if a system felt that 50 percent price protection was the key objective (i.e., there should be enough fuel in the inventory to defer 50 percent of the new diesel fuel costs), under the market scenarios a 140-day inventory would be needed for a minor disruption and a 334-day inventory would be needed for a moderate disruption. Neither, by the way, could be considered reasonable levels, so that a 50 percent price protection objective turns out to be practically unattainable].

The second question that needs to be answered is whether or not a reasonable contingency inventory should provide supply protection for both a minor and moderate disruption? If it provides supply protection for a moderate disruption (i.e., 90 days) it will at the same time provide more than three times the supply protection needed in case a minor disruption occurs instead (i.e., 25 days). Or to put it another way, a contingency inventory which provides reasonable supply protection for a moderate disruption lasting one year could provide similar protection for three minor disruptions each lasting one year and each coming on the heels of the other. It is the contention here that a contingency inventory which provides reasonable supply protection for a moderate disruption is <u>not an overall reasonable level of inventory</u>. There are three reasons for this contention: 1) if a moderate disruption occurs, SPR release is a strong possibility, which will lower any shortage and thus reduce necessary supply protection; 2) three successive one-year minor disruptions are highly unlikely; and most importantly 3) the 90-day inventory necessary for the moderate disruption is at the far extreme of inventory level which transit systems currently provide; it is not reasonable, therefore, to expect any significant number of transit systems to implement such a major shift in inventory policy.

As a result, the 25-day inventory is considered as the reasonable contingency level.

A responsive contingency fuel inventory policy is one which is cognizant of economic conditions. The security which a contingency inventory offers must be balanced against interest rate trends, diesel fuel price trends and the current likelihood of a long or moderate disruption. Either of two major actions follows as a result of constantly comparing contingency objectives against economic realities: 1) the rate of filling, maintaining or draining the contingency inventory will continually shift as contingency and economic priorities shift over time, or 2) the contingency inventory will be filled and continuously maintained with the aid of government incentives that counteract adverse economic conditions.

Finally, in summarizing the three proposals described under the alternative of new fuel procurement procedures, the following describes their potential value during oil disruptions:

- Cooperative fuel purchasing arrangements will create a more innovative procurement mandate which, along with the leverage that a co-op affords, will allow transit systems to participate in various contingency actions, including the futures market, an SPR auction, any possible SPR options auction, joint contingency inventories, joint fuel lending and even joint contingency budgets.

- The heating oil futures market can provide a revenue supplement and/or a contingency fuel supply source during a disruption.

- A contingency fuel inventory can be set up which will provide a reasonable level of fuel supply protection during a minor disruption (and a less than reasonable level of protection during a moderate disruption) under the worst (i.e., institutional) fuel availability conditions. The same contingency inventory will also provide price protection during minor and moderate disruption under the worst (i.e., market) fuel price conditions, although no standard reasonable level of protection can be devised at the time of this writing (i.e., 1984).

5.5.6 Emergency Assistance Measures

Extraordinary emergency measures could be adopted for transit systems to adequately function during potentially year-long supply disruptions. These measures include the following:

1. Subsidies (including use of Economic Response Block Grants) and/or fare increases to cover increased fuel costs;

2. Service cuts or readjustments in response to fuel supply reduction and/or cost increases;

3. Shift to lesser quality fuel.

These are described below.

1. Subsidies and Fares - Fuel costs represent approximately seven percent of total transit expenses, or about $35-40 million per month nationwide (22). Under the market scenarios of minor and moderate disruptions, these costs would nearly double and triple, respectively (and increase even more if systems opted for increased services). Faced with these increased costs, transit systems can either a) borrow from the remaining annual fuel budget (bargaining on a short disruption and deferring revenue generation to a later time), b) cut down on fuel consumption and service (to the lower limit of maintaining current costs as shown in Figures 5.8 and 5.9) or c) raise revenues to match expenses. The first option is fraught with risk; as Figures 5.5 and 5.12 show, if a disruption continues for any length of time the entire fuel budget can be consumed rather quickly. It is not a real alternative, therefore. The second option is discussed in the next section as a viable choice. The third option involves some mix of raising fares and added subsidization. Raising fares during a disruption (particularly within market scenario disruptions when the economy is affected by higher unemployment and inflation, and lower income) is an undesirable action. However, normal subsidy channels will at the same time be hardpressed to increase financial support to transit systems because of declining government revenues (24).

The one possible source for subsidy aid would be through temporary Federal block grants to the states. Chapter 4 discussed these block grants as one of a number of standby economic response measures under consideration by the Federal government. State governments would use the block grants at their discretion, although likely recipients would include transit systems with higher costs and greater responsibilities during disruptions. Funding for the programs would likely come from one or both of the two sources of Federal income expected to increase during a disruption: the oil windfall profits tax and/or sales receipts from released SPR oil.

Thus, use of federally sponsored block grants to states to cover added transit costs is one alternative. In lieu of such support or even in conjunction with this subsidy measure, temporary fare increases are recommended as an alternative.

2. Service Cuts - If subsidies and/or fare increases are not implemented or if fuel supplies are not available via other methods, then a reduction in service (i.e., VMT) the as an alternative for coping with cost and/or supply impacts during a disruption. As explained, the maximum level of such cuts would maintain pre-disruption fuel costs via a significant drop in VMT (i.e., used in market scenario disruptions). Less serious service cuts would respond directly to any loss in fuel availability (i.e., used in institutional scenario disruptions). Between "maximum" and "no" use of this alternative are a whole number of possible service cuts responding to the degree of effectiveness of a) subsidies and fare increases, and/or b) fuel recovery alternatives described earlier on.

3. Shift of Fuel Type - Last among the temporary coping measures would be a shift by those transit systems using diesel fuel #1 (or a blend of #1 and #2) to exclusive use of diesel fuel #2. (Chapter 3 discussed the difference between the two fuels.) The reasons for the switch are a) lesser expense of #2 vs. #1 and b) greater likelihood of availability of #2 vs. #1. Concerning the former reason, while the prices of diesel fuel #1 and #2 will both increase dramatically under market scenarios, the cost difference between the two fuels will remain, allowing systems which ordinarily use #1 to reduce their expected costs somewhat by using the less expensive #2.

Concerning the second reason, there is some evidence that in past disruptions suppliers sometimes met unsatisfied demand by producing a cheaper, somewhat inferior product (25). There is a likelihood, therefore, that suppliers may assume a similar policy and produce lesser quality diesel fuels #1 and #2 in order to increase the availability of diesel fuel (mainly #2) in light of shortages. Given this possibility, it would make economic sense for transit systems to switch to a known lower quality #2 fuel, benefiting from lower prices and greater availability, rather than risk variable fuel quality and certain higher prices of diesel fuel #1.

In summary, this alternative indicates how temporary coping measures can assist transit systems. The measures include a) utilizing federally-sponsored economic response block grant funds if implemented (and/or fare increases) to pay for fuel price increases, b) service cutbacks to compensate for fuel price increases (in lieu of or along with subsidy/fare action) or fuel supply loss, and c) switching to cheaper, more available (but lower quality) diesel fuel #2.

# CHAPTER 6

# EVALUATING THE ALTERNATIVES FOR RELIEVING DISRUPTION IMPACTS

## 6.1 Evaluation Criteria

The purpose of this chapter is to evaluate the six alternative actions identified in Chapter 5, which are intended to alieviate the impacts experienced by transit systems in future oil supply disruptions. The evaluation process used here is comprised of three groups of criteria: 1) uncertainty criteria, 2) transit service criteria, and 3) secondary impact criteria.

### 6.1.1 Criteria 1: Uncertainty

The first group of criteria is based on the considerable uncertainty inherent in supply disruptions. Six factors are noted:

1. A disruption may occur immediately, at some later undetermined time or never;

2. A disruption could be of minor or moderate magnitude (it could also be of major magnitude, but as already noted, such an overwhelming disruption and the required response transcend the scope and concerns of this document);

3. A disruption could last for as long as a year or end at a considerably earlier time;

4. A disruption could produce regular supply shortages to consumers or no shortages;

5. A disruption could produce major and immediate fuel price changes or only minor and gradual fuel price changes;

6. In addition to these points there are other uncertainties which have only been briefly discussed, including:

   a. A series of disruptions could reoccur in relatively quick succession or a disruption could be an isolated event;

   b. In a related possibility, a disruption could develop slowly, with production removed gradually, or it occur rapidly, with production cut sharply.

The best alternative would be fully adaptable to the full range of possibilities. The worst alternative would not be accountable to any of the criteria and could only perform within a strict set of conditions.

### 6.1.2 Criteria 2: Transit Service

The second criteria evaluates how each alternative forces or allows a transit system to

a. cut current services, or

b. maintain current services, or

c. expand current services

in light of disruption impacts.

### 6.1.3 Criteria 3: Secondary Impacts

These criteria relate to the secondary impacts of alternatives. These are the following:

- costs of alternatives (to various parties);
- institutional concerns of implementing alternatives (which are many); and
- impact on other oil consumers (and suppliers as well).

At the conclusion of this chapter, the evaluations under each set of criteria are summarized. As a guide to readers, Table 6.1 can be used to identify how the evaluation process is laid out in Chapter 6.

## 6.2 Uncertainty Criteria Evaluation

### 6.2.1 Will a Disruption Occur and When?

Table 6.2 shows how each alternative measures up to this most basic criterion. Basically, three of the alternatives could be effectively implemented if a disruption occurred immediately: Federal Allocation, SPR Release and State Set-Aside. However, each requires some degree of startup time and activities. Federal Allocation would require new legislation with or without associated administrative code. SPR Release has been tested and auction processes proposed (1), but the directed sales component remains unplanned and would require considerable communication and logistical planning among the Federal government, transit systems and oil suppliers. Many states have set-aside authority but few have either a program developed or the administrative staff necessary to implement the program. But all these actvities could be performed in a very short time if the need were recognized. Furthermore, Table 5.2 indicated that supply shortages, which all three of these alternatives address, would not become a relatively serious problem until two months following the start of an institutional scenario disruption. That should allow adequate time for effective implementation of these alternatives.

Fuel Procurement Procedures are obviously currently in effect in 1983-84, but as a result only the contractual arrangements are of relevance; inventories are currently at a level which provides virtually no contingency support. New Fuel Procurement Procedures would have no effectiveness in an immediate disruption because they are not utilized to any significant extent as of this writing (i.e. 1984). Finally, Emergency Assistance Measures would only be somewhat effective in an imminent disruption, with the block grant component least likely to be available for any immediate assistance, but with service cuts

TABLE 6.1

GUIDE TO THE EVALUATION PROCESS IN CHAPTER 6

| Alternative Evaluation Process | Relevant Section in Chapter 6 |
|---|---|
| I. Uncertainty Evaluation | 6.2 |
| A. Disruption Timing | 6.2.1 |
| B. Disruption Magnitude | 6.2.2 |
| C. Disruption Length | 6.2.3 |
| D. Disruption Supplies | 6.2.4 |
| E. Disruption Prices | 6.2.5 |
| F. Disruption Reoccurence | 6.2.6 |
| G. Disruption Development | 6.2.7 |
| II. Transit Service Evaluation | 6.3 |
| A. Current Fuel Procurement | 6.3.1 |
| B. Federal Allocation | 6.3.2 |
| C. SPR Release | 6.3.3 |
| D. State Set-Aside | 6.3.4 |
| E. New Fuel Procurement | 6.3.5 |
| F. Emergency Action Measures | 6.3.6 |
| III. Secondary Impact Evaluation | 6.4 |
| A. Costs | 6.4.1 |
| B. Institutional Concerns | 6.4.2 |
| C. Oil Market Impacts | 6.4.3 |
| IV. Evaluation Summary | 6.5 |
| A. Uncertainty Evaluation | 6.5.1 |
| B. Transit Service Evaluation | 6.5.2 |
| C. Secondary Impact Evaluation | 6.5.3 |

TABLE 6.2

SUMMARY OF EVALUATION OF ALTERNATIVES AGAINST THE CRITERION OF DISRUPTION TIMING UNCERTAINTY

Effectiveness of Alternative if Disruption Occurs:

| Alternative | Now | Later | Never |
|---|---|---|---|
| 1. Current Fuel Procurement | Contracts in effect; inventory ineffective. | Contracts in effect; inventory ineffective. | Contracts restrict cost savings; Low inventory justified. |
| 2. Federal Allocation | Effective; can be started within 2 months. | Effective; can be started within 2 months. | Need not be implemented. |
| 3. SPR Release | Effective; general release immediately, directed sales within 2 months. | Effective; general release immediately, directed sales within 2 months. | Need not be implemented. |
| 4. State Set-Aside | Effective; can be started within 2 months. | Effective; can be started within 2 months. | Need not be implemented. |
| 5. New Fuel Procurement | Not effective because not in place. | Effective. | Cost savings realized; contingency inventory represents financial drain. |
| 6. Emergency Assistance | Service cuts effective; fare & fuel changes may be delayed; block grants need planning. | Effective. | Need not be implemented. |

available as an almost immediate measure. Temporary fare increases and switching to diesel fuel #2 might still encounter institutional roadblocks, even with a strongly recognized need for assistance, such as to delay their availability for some time after the service cut option.

If instead, a disruption were delayed until some later time, the effectiveness of a number of alternatives would likely improve. The SPR would be bigger, allowing for larger drawdown rates. A larger number of transit systems could institute New Fuel Procurement Procedures, having the time and experience to explore and even test various measures. Block grant programs could be further planned and guidelines established by the Federal government as well as state recipients. The overall effectiveness of Federal Allocation, State Set-Aside and existing Fuel Procurement Procedures would remain the same if a disruption occurred later rather than imminently. There is no reason to believe that transit systems (for the most part having discontinued contingency inventories as of this writing) will change inventory practices especially as the memory of the last (1979) disruption fades (unless transit systems adopt the inventory concept laid out under the New Fuel Procurement Procedures alternative).

If events are fortunate (as well as unlikely) and another oil disruption does not occur, only the two fuel procurement alternatives will have any effect; the others simply will not be implemented. Under Current Fuel Procurement Procedures, those transit systems maintaining minimum operating inventories will have guessed correctly and benefited financially. On the other hand, the large number of systems which regularly maintained long-term fuel purchasing procedures will have missed out on the financial benefits which short-term contracts, deferred contractual purchasing, and even the heating oil futures market will have offered from time to time. Those benefits would likely be realized by systems engaging in New Fuel Procurement Procedures, along with the major benefit of greater price leverage via cooperative fuel purchasing. However the contingency inventory would represent a financial loss (even if managed in a manner responsive to economic conditions) if no disruption ever arose.

In summary, only those alternatives intended to supplement transit system fuel supply could be effectively and fully implemented in an immediate disruption. If a disruption were delayed until some later time, some alternatives would improve in their ability to be implemented. Transit systems practicing on-going fuel procurement practices maintain, and are likely to continue to maintain fuel inventory supplies which are not satisfactory for contingency purposes. If a disruption never were to occur, these low inventory levels would be justified, but the lack of innovation in fuel purchasing would mean an avoidance of possible financial gain. New fuel procurement procedures could help realize those gains but would also expend funds for a reasonable contingency inventory which would be unutilized if no disruption occurred. Other alternatives simply would not be implemented if no disruption occurred.

### 6.2.2 Will a Disruption be Minor or Moderate?

All alternatives are applicable to both minor and moderate disruptions. But the utility of some of the alternatives under the two disruption types is limited by either inherent assumptions or by overall energy policies. Under

New Fuel Procurements Procedures, a contingency inventory of 25 days supply was considered reasonable. This would completely protect against supply allocation in a minor disruption but have considerably lesser impact in a moderate one. SPR Release in a directed sales format would be effective in a disruption of either magnitude, but as of the early to mid-1980's a strong opinion among government energy policymakers (supported by much of the oil industry) for use of the SPR only in moderate or severe disruptions. Finally, it is somewhat questionable, (only because a moderately sized disruption such as those described in Chapter 5 have never been experienced) as to what extent contractual agreements will even be partially honored (be they long-term, short-term or futures contracts). If oil distributors a) recognize the market incentives and b) assume the risks of alienating consumers and spurring government re-regulation, then they could partake in a virtual business free-for-all where contracts are broken and reformed (2). While this free-for-all scenario is only an unlikely offshoot of the market scenario, it a) has a higher probability in a moderate than in a minor disruption, b) would negate the usefulness of alternatives based on contractual agreements and c) would enhance the utiliy of government allocation alternatives (i.e., Federal Allocation, SPR Release and State Set-Aside).

In summary, there are two alternatives with utility in minor vs. moderate disruptions differs for two alternatives. A reasonable contingency inventory is more effective for minor disruptions than for moderate ones, while the opposite is true for SPR Release. The reasons have to do with exogeneous policy factors: defining a reasonable inventory and deciding when to use the SPR. There remains the further unlikely possibility that alternatives based on contracts could be completely ineffective in moderate disruptions.

### 6.2.3 How Long Will a Disruption Last?

All alternatives have been devised to provide assistance during a year-long disruption. But disruptions can last a far shorter time, especially given the appropriate conditions (i.e., low energy demand, high pre-disruption inventories, relatively high non-OPEC oil production utilization). Some alternatives are equally helpful no matter what the disruption's length. Federal Allocation and State Set-Aside can provide continual fuel supplies to transit systems to meet all requirements throughtout the lives of these alternatives. Contractual agreements (to the extent they are honored) between suppliers and transit systems continue until their completion. If a supply contract ends during a disruption, the supplier may be required to renew if the consumer so requests (3). All the Economic Assistance Measure options relieve whatever financial and/or suppy problems are unmet by other alternatives from the time they are implemented to the time they are ended.

Some alternatives, however, are less effective if a disruption ends sooner than expected. SPR Release is expected to occur at a conservative drawdown rate, which trades off reacting to economic and/or supply problems with major relief for the possibility of an extended disruption. The same can be said for a transit system utilizing its own reasonable contingency inventory at a low drawdown rate during a moderate disruption in expectation of a long duration disruption rather than relying on a major drawdown which would provide more assistance and gambling on a shorter duration disruption.

### 6.2.4 Will There be Supply Shortages?

If supply shortages occur during disruptions, the various alternatives will have the effects described in the following subsections.

1. Current Fuel Procurement Procedures. Shortages will occur if supplies are allocated. Some transit systems may be able to benefit from generous allocation percentages or allocation schemes which favor public transportation services, in both cases resulting in smaller stortages. For some other transit systems, however, the effects could even be worse. Those systems which maintain long-term contracts but regularly defer a portion of deliveries for less-expensive spot purchases may find that their allocation may be based not on the contracted monthly delivery level but on the actual monthly delivery level. Additionally, those systems employing short-term contracts with suppliers who rely on spot market products (e.g., Chicago's RTA) may be faced with defunct supply relationships, as those suppliers are priced out of business. Thus, while long-term contractual agreements are no insurance against monthly supply shortages (roughly equal to the level of disruption magnitude), maintaining such agreements will insure against shortages considerably larger than general allocation fractions, including the possibility of total fuel cutoff.

Ironically, the allocation system does allow transit systems to recoup a small portion of their supply shortages through spot market purchases during a disruption. As Chapter 5 described, allocation occurs during the institutional scenarios partly because of slow price increases. Since transit systems are supplied with less fuel and since each gallon of fuel is only somewhat more expensive than during the pre-disruption period (see Table 5.3), transit systems would spend only 98 percent of their annual fuel budgets during year-long minor disruptions and only 91 percent of their budgets during moderate disruptions (i.e., current budget times price increase times allocated supply). During disruptions, these funds could be utilized to supplement monthly supplies by purchases of diesel fuel in the spot market. Since the spot market is the epitome of the market environment, it would be safe to assume that diesel fuel prices purchased from the spot market would be equal to the equilibrium prices predicted under the market scenarios (see Table 6.3). With that as given, transit systems would be able to reduce supply shortages from seven to six percent and from 26 to 23 percent during minor and moderate disruptions, respectively, by using unspent budgeted funds on spot market purchases.

Inventory fuel supplies will have no effect on transit system supply shortages because of the generally low levels maintained.

2. Federal Allocation. A Federal mandated allocation of 100 percent of transit needs would, obviously, restore full monthly supplies to all transit systems. In actual practice, some of these systems may require less fuel if more favorable allocation fractions can be obtained from their suppliers. But more fuel could also be required if short-term agreements fail.

3. SPR Release and Directed Sales. A more likely, conservative drawdown rate is one which leaves at least half the SPR intact at the disruption end. At its current 1983-84 volume of approximately 375 million barrels of crude oil, a conservative drawdown rate is 0.5 million barrels per day. As

TABLE 6.3

SUPPLY SHORTAGES FACED BY TRANSIT SYSTEMS
WITH AND WITHOUT SPR DRAWDOWN

| Disruption Size* | % Supply Shortfall With No SPR Release | % Supply Shortfall with SPR Release (100% Auctioned) When Disruption Occurs:** | | |
|---|---|---|---|---|
| | | 1983-84 | 1986 | 1990 |
| Minor | 7% | 4% | 2% | 0.4% |
| Moderate | 26% | 22% | 21% | 19% |

* Disruptions are institutional scenario disruptions, since market scenarios predict no supply shortages.

** SPR released at conservative drawdown rate: i.e., now 500,000 barrels per day; 1986 - 750,000 barrels per day; 1990 - 1 million barrels per day. All released fuel is distributed via auction process.

the SPR increases in size, however, the size of a conservative drawdown increases with it. By 1986, if the SPR reaches 500 million barrels per day as expected, a conservative drawdown rate would be approximately 700,000 barrels per day. At its (currently planned) ultimate size of 750 million barrels (to be reached by the late 1980s or early 1990s) a conservative drawdown rate would be 1 million barrels per day.

If all of the supplies being drawn down by the SPR were distributed via the auction process (or by either of the alternative methods, namely refiner allocation or options market) supply shortages predicted by the institutional scenario disruptions described in Chapter 5 would be lessened, as Table 6.3 indicates. However, only during a minor disruption which occurs sometime after 1990 (when the SPR will be at full capacity) would the full current supply needs of transit systems be met. In all other cases, shortages would still occur. Therefore, SPR directed sales would be necessary to eliminate transit system shortages occurring under both disruptions at any given point of time. The amount of SPR fuel needed to perform this function would not be a significant burden on the SPR. Given the worst case, a moderate disruption occurring in 1984, all the nation's transit systems would face a 26 percent shortage, translating into 211,000 barrels per month or nearly 7,100 barrels per day. A general auction of 90 percent of SPR supplies (i.e., 500,000 barrels per day) would reduce the cumulative shortage of transit systems to 22 percent or about 6,100 barrels per day. That amount is equal to only 12 percent of the 50,000 barrels per day available from SPR reserves for directed sales functions.

4. State Set-Aside. Like the Federal Allocation alternative, State Set-Aside would restore full monthly supplies to all transit systems. The amount of set-aside fuel necessary to perform this function is not large. Using a similar worst case, that of a moderate disruption (in which transit systems nationwide lose 211,000 barrels of fuel per month) and where states can take only two percent of total first-time distillate sales, the amount needed to fulfill current transit needs represents only 13 percent of the 1.7 million barrels monthly available to all 50 states via monthly set-aside.*

5. New Fuel Procurement Procedures. A number of these procedures could provide some or total protection against transit fuel shortages. First of all, cooperative fuel purchasers could potentially generate the knowledge and income to participate in the auction process for SPR crude oil if it turned out that the Federal government would not implement the associated directed sales program (or implemented it but not for transit needs). It is impossible to say here, however, how successful transit systems would be in such a venture, since the auction would be opened up to a multitude of prospective buyers.

Another option would be to take delivery on heating oil futures contracts (or, more likely, trade these contracts to suppliers for diesel oil deliveries). The minimum size futures contract is for 1,000 barrels; therefore some 57 monthly contracts would be needed for minor disruptions and 211 monthly contracts would be needed for moderate disruptions. In March 1984, there

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* That is, one billion barrels in annual U.S. distillate sales divided by 12 equals 83.3 million barrels monthly; multiplied by 2 percent equals 1.7 million barrels available for set-aside to all states each month.

were over 18,000 heating oil contracts available on the New York Mercantile Exchange, although 96 percent of these were for delivery over the next three months (4). Thus, the futures market would likely be able to serve as an emergency supply source only for a limited period, although transit systems could purchase more than their needed amount, sell that to oil suppliers in exchange for an equal amount of diesel fuel spread out over a longer period of time (with the supplier assuming the risk that diesel fuel prices will rise in the future and with transit system assuming the risk that diesel fuel prices will fall).

A third and more obvious source of fuel would be from a contingency inventory supply held by a transit system (or a consortium of transit systems). The 25-day reasonable supply would provide transit systems with pre-disruption fuel requirements in the event of a minor disruption. In the event of a moderate disruption (and if drawn down at a rate similar to that during a minor disruption), the contingency inventory would reduce the shortages to transit systems from 26 percent to 19 percent.

As with Current Fuel Procurement Procedures, excess funds left over from unused fuel budgets can be transferred into spot market purchases. Unlike the former alternative, however, these funds can be supplemented by other sources of income. SPR supplies purchased from the auction process can be sold outright (rather than arranging refining or trade agreements) and the income used to buy diesel fuel on the spot market. The same could be done with heating oil futures contracts. All told, the results should be greater funds for spot market purchases than would be available without these actions, meaning a smaller supply shortages than under procedures existing in 1983-84.

6. Emergency Assistance Measures. These offer two ways for reducing disruption-related supply shortages. First, subsidies and/or fares could be increased to a level where transit systems could purchase additional fuel on the spot market. Using the assumption that transit systems could make up disruption shortages through spot market purchases if they had the available funds, then all transit systems would need a total of $3.5 million monthly during a minor disruption and $20.1 million monthly during a moderate disruption in order to make up for shortages via the spot market (see Appendix B for derivation).

The second means of reducing shortages is by switching from diesel fuel #1 to #2 and (assuming the same allocation fraction holds and the $0.05 price spread between the two fuels remains constant during a disruption) using the cost savings to purchase additional diesel fuel #2 on the spot market. This measure would reduce supply shortages from seven to three percent duing a minor disruption and from 26 to 21 percent during a moderate disruption. The measure is relevant, obviously, only for those systems which are currently using diesel fuel #1.

7. Summary. Table 6.4 summarizes the effectiveness of each alternative as a means of allieviating supply shortages which would occur as a result of oil supply disruptions under institutional scenario conditions. There are a number of ways of eliminating shortages and a number of others which can only reduce the levels of shortages. Those measures which will have no effect on reducing shortages are the existing and widespread long-term con-

TABLE 6.4

SUMMARY OF EVALUATION OF ALTERNATIVES AGAINST THE CRITERION OF DISRUPTION SUPPLY SHORTAGE UNCERTAINTY

| Alternative | Impact on Supply Shortage During: Minor Disruption | Moderate Disruption |
|---|---|---|
| 1. Current Fuel Procurement | | |
| a. Long-term contract | a. No effect. | a. No effect. |
| b. Short-term contract | b. Possible large shortage. | b. Possible large shortage. |
| c. Use spot market during disruption | c. Reduce shortage from 7 to 6% | c. Reduce shortage from 26 to 23%. |
| d. Inventory | d. No effect. | d. No effect. |
| 2. Federal Allocation | Eliminate shortage. | Eliminate shortage. |
| 3. SPR Release | | |
| a. Auction only | a. Reduce shortage (i.e., w/o SPR: 7%; w. SPR now: 4%; w. SPR '86: 2%; w. SPR '90: 0.4%). | a. Reduce shortage (i.e., w/o SPR: 24%; w. SPR now: 22%; w. SPR '86: 21%; w. SPR '90: 19%). |
| b. Auction & directed sales | b. Eliminate shortage. | b. Eliminate shortage. |
| 4. State Set-Aside | Eliminate shortage. | Eliminate shortage. |
| 5. New Fuel Procurement | | |
| a. SPR auction participant | a. Reduce shortage; uncertain outcome. | a. Reduce shortage; uncertain outcome |
| b. Futures deliveries | b. Eliminate shortage but only briefly. | b. Eliminate shortage, but only briefly. |
| c. Inventory | c. Eliminate shortage. | c. Reduce shortage from 26 to 19%. |
| d. Use spot market during disruption | d. Reduce shortage (more than under current procurement). | d. Reduce shortage (more than under current procurement). |
| 6. Emergency Assistance | | |
| a. Subsidies/Fares | a. Eliminate shortage. | a. Eliminate shortage. |
| b. Switch to #2 | b. Reduce shortage from 7 to 3%. | b. Reduces shortage from 26 to 21%. |

tractual and inventory practices of transit systems, currently the only alternative which is firmly established as a likely coping measure.

### 6.2.5 Will There be Major Price Increases?

Price increases will occur under either institutional or market scenarios of disruptions, but only in the latter will those increases be both precipitous and of significant size. The effects of the different alternatives on these price changes are evaluated below.

1. Current Fuel Procurement Procedures (Circa 1984). Any transit system having fixed-price contracts will benefit. But as Chapter 3 noted, very few systems have pursued this option. No other aspect of current fuel procurement procedures offers any protection against large cost increases. Even worse, those systems with contracts lacking price de-escalation clauses could be saddled with market scenario price increases throughout the life of the contract, even if the disruption ends earlier and prices begin to decline.

2. Federal Allocation. This alternative offers no protection against either small or large price increases. Under the market scenarios, even if supply shortages were a problem for some transit systems, a far greater problem would be paying for the fuel for which this alternative provides.

3. SPR Release and Directed Sales. The release of SPR fuel will have a significant impact on the major price increases experienced under market scenarios. The level of that impact is difficult to determine, but it is likely to be most pronounced if two conditions are met regarding distribution of SPR supplies. First, SPR supplies would have to be sold at market prices, to discourage stockpiling (5). Secondly, supplies would have to be distributed early on in the disruption so as to play an initial and important role in the determination of new equilibrium prices (6). The joint effect of these conditions is to demonstrably increase usable crude supplies in light of expected import reductions, thereby increasing supplier and consumer confidence and lowering spot market purchases, all of which tends to lower equilibrium prices. It is because of the importance of these two conditions, as a matter of fact, that causes some economists to support an SPR options auction (which transfers the so-called trigger mechanism on SPR use to the private sector) and to oppose a refiner allocation system (with less than market prices and no guarantees against stockpiling) (7).

The directed sales component of SPR Release, however, will offer no protection against either small or large price increases experienced by transit systems. As with Federal Allocation, even if such sales are necessary in limited cases under the market scenarios, a far greater problem would be paying for the fuel which this measure provides.

4. State Set-Aside. As with Federal Allocation and SPR Directed Sales, this alternative offers no protection against small or large price increases experienced by transit systems.

5. New Fuel Procurement Procedures. Two measures offer a degree of price protection in the event of major price increases experienced by transit systems under market scenarios of minor and moderate disruptions. First, the heating oil futures market is a good arena for converting the financial

gains earned due to rapidly rising foward (i.e., actual delivery) prices vs. fixed futures contract prices into funds available to purchase higher priced diesel fuel. Because of the volume of 1,000 barrels contracts traded on the New York Mercantile Exchange, it is feasible to hedge entirely the monthly deliveries of all U.S. transit systems (i.e., 812 contracts) on the futures market. The level of price protection offered would be dependent upon the similarity of futures to equilibrium prices during the disruption. Theoretically, though, all transit systems could receive 100 percent protection against price increases through proper buy/sell activities on the futures market if all supplies were hedged. Practically, however, the level of price protection would be significant but not comprehensive. Furthermore, once a disruption begins, price protection beyond the first three to four months may not be possible, (or at best, not be significant) due to the limited number of heating oil futures contracts available for three to four months beyond the current period.

Secondly contingency fuel inventories offer a small degree of price protection, if the inventory was built with pre-disruption supplies paid for at pre-disruption prices. The major monthly cost increases for the market scenario would be reduced by 3 percent and 5 percent under minor and moderate disruptions, respectively, assuming that the 25-day inventory is drawn down at the same rate described earlier. (i.e., substituting on a daily basis seven percent of higher priced fuel with lower priced inventory See Appendix B for more information.)

6. <u>Economic Assistance Measures</u>. Subsidies and/or fare increases could theoretically be raised to a level which would fully compensate transit systems for the major price increases occurring under market scenario disruptions. For the nation's transit systems that would mean a total of $26.3 million monthly during a minor disruption and $62.4 million monthly during a moderate disruption (i.e., 812,000 monthly barrels used nationwide times price increase = subsidy or fare compensation). As shown in Table 6.11, this corresponds to the equivalent of 8% and 18% fare increases respectively, to maintain the pre-disruption VMT.

Costs could also be reduced slightly if those transit systems using diesel fuel #1 switched to #2 (assuming that the $0.05 price spread between the two fuels remains constant during a disruption). The major monthly cost increase shown in Figures 5.3 and 5.4 for the market scenario would be reduced by 3 percent and 2 percent under minor and moderate disruptions, respectively (i.e., in minor disruption, $0.05/$1.77 = 3 percent; in moderate disruption, $0.05/$2.83 = 2 percent).

7. <u>Summary</u>. Table 6.5 summarizes the effectiveness of each alternative as a means of alleviating major cost increases which would occur as a result of oil supply disruptions under market scenario conditions. There are two measures which could provide full compensation for price increases: price-fixed contracts (which are practically non-existent in the transit industry as of this writing), and subsidies and/or fare increases. Two other measures could significantly reduce costs: a quick auction of SPR supplies (which would lower all oil product equilibrium prices) and successful heating oil futures market hedging (which would provide added income for purchasing higher priced diesel fuel). Drawing on contingency inventory and switching to diesel fuel #2 produces very minor reductions in cost increases. Three

TABLE 6.5

SUMMARY OF EVALUATION OF ALTERNATIVES AGAINST THE CRITERION OF DISRUPTION COST INCREASE UNCERTAINTY

| Alternative | Impact on Supply Shortage During: Minor Disruption | Moderate Disruption |
|---|---|---|
| 1. Current Fuel Procurement | Price-fixed contracts effective but rare; lack of de-escalation clause extends disruption prices. | Same as minor disruption |
| 2. Federal Allocation | No effect | No effect |
| 3. SPR Release | | |
| a. Auction | Significant price reduction. | Significant price reduction. |
| b. Directed sales | No effect | No effect |
| 4. State Set-Aside | No effect | No effect |
| 5. New Fuel Procurement | | |
| a. Futures market | Significant cost reduction possible. | Significant cost reduction possible. |
| b. Inventory | Cost increase reduced by 3%. | Cost increase reduced by 5%. |
| 6. Emergency Assistance | | |
| a. Subsidies/Fares | Full price increase compensation possible. | Full price increase compensation possible. |
| b. Switch to #2 | Cost increase reduced by 3%. | Cost increase reduced by 2%. |

measures which could completely eliminate fuel shortages under institutional scenarios (i.e., Federal Allocation, SPR Directed Sales and State Set-Aside) have no effect on costs.

### 6.2.6 Will Disruptions Reoccur in Close Succession?

If disruptions occured in relatively close succession, most alternatives could simply be continued or easily re-instated. Indeed, the SPR Release alternative has as its basis (i.e., the conservative drawdown rate) the concern that another disruption could follow the first so quickly as to not allow adequate rebuilding of SPR stocks. The drawdown rates proposed would see the SPR through two, closely-spaced, year-long disruptions. Some measures, however, would be less effective in a single or series of closely following disruptions. Transit systems may not reap any financial benefits from the heating oil futures market if the intermediary period of constant supply is too short. The 25-day contingency inventory would be completely utilized at the end of a first year-long disruption.

### 6.2.7 Will Disruptions Develop Rapidly or Slowly?

This is the last criterion in the Uncertainty Evaluation. In the disruption scenarios described in Chapter 5, free world oil production drops suddenly, causing all other relevant price and product supply changes. But as Chapter 4 pointed out, in 1979 the crisis was composed of separate disjointed disruptions, the first of which developed relatively slowly, causing only slight impacts on price and product supply. A future disruption could develop in a similar way, with the impacts following either the market or institutional scenarios but to a lesser degree. If a disruption were to occur according to a slower chain of events, those alternatives relying upon direct government action would be less effective because of a lesser likelihood of their being implemented. Federal Allocation, SPR Release and block grants to states all require the Federal government to acknowledge the existence of a disruption and then to act upon that acknowledgement appropriately. The same is true for governors with regard to State Set-Aside. In both cases, such acknowledgement and action are less likely to occur in a slowly developing crisis, since all parties wish to avoid extraordinary measures in the hope that the situation will clear up by itself. By the same token, transit systems traditionally postpone fare increases, service cuts and subsidy requests to a crisis point when no other choices are feasible. Thus these options too may not be reasonably available in a slowly developing disruption.

However, various options available under the New Fuels Procurement alternative can be effectively used in a disruption which develops slowly or rapidly. Contingency inventories can be drawn down at any point. Heating oil futures contracts can be converted to additional revenue of necessary supply at any point. In addition, during a slowly developing disruption, transit systems participating in cooperative fuel procurement can begin to plan for the next supply contract, recognizing that current trends may have possible near-term impacts and that certain contractual provisions should be altered (e.g., rate of posted price increases, delivery rate, even the possibility of explicitly stating disruption allocation plans in the body of the contract itself).

By the same token, Current Fuel Procurement Procedures are not affected by the rate of development of a disruption; their general lack of effectiveness remains in either case.

## 6.3 Transit Service Criteria Evaluation

The second step in the process of evaluating alternatives builds directly on the Uncertainty Evaluation. There it was established how well the alternatives fare under a wide range of possible disruption characteristics. Given that, it needs to be determined to what extent transit systems can actually restore or expand transit service during a disruption.

In the past disruptions, in which supply was guaranteed and price increases were low, many transit systems reported peak-period capacity problems due to a ridership surge (8). In response, systems took various actions which can be generally grouped as follows:

1. Increased service using more or bigger buses or more roadway capacity, including:

   a. new vehicles
   b. larger vehicles
   c. exclusive high occupancy vehicle lanes
   d. use of private vehicles
   e. use of school buses
   f. use of retired buses.

2. Change in operating and maintenance procedures, and policies, including:

   a. deferring maintenance
   b. adjusting routes and schedules
   c. instituting/expanding express bus service
   d. instituting/expanding demand-responsive services
   e. changing service standards (more crowding)
   f. changing marketing practices
   g. using TSM techniques.

3. Change in demand, including:

   a. variable work hours
   b. peak/off-peak fare differentials (9).

In future disruptions, transit systems may choose to take similar actions. One source recommends three separate packages of actions to take during oil supply disruptions depending upon the severity of the peak-hour capacity problem (10). But, on the other hand, if serious fuel price increases occur during a disruption, transit systems perhaps should be concerned primarily with actions that will reduce costs rather than improve services. The selection of actions will depend upon various factors specific to the transit system (e.g., size of reserve fleet, peak vs. off-peak service, current passenger loading/capacity ratios, etc.) and the urban area (e.g., CBD employment share, relationship of transit system to other local governments, etc.). But the spectrum of possible actions will necessitate either a reduction, a maintaining or an increase in current services (which is defined here as VMT provided). Table 6.6 classifies some available actions in terms of what level of service (VMT) is required. The disruptions presented in Chapter 5, however, indicate that transit systems may not be able to choose among these

TABLE 6.6

LEVEL OF SERVICE (VMT) REQUIRED TO IMPLEMENT SOME ACTIONS IN RESPONSE TO OIL DISRUPTIONS

| Action | Pre-Disruption VMT should be Maintained/ Increased/Reduced in Order to Implement |
|---|---|
| A. Meet Peak-Hour Capacity Problems* | |
| 1. Allow additional crowding | Maintain |
| 2. Variable work hours | Most likely maintain; possibly increase. |
| 3. Four day work week | Most likely maintain; possibly decrease. |
| 4. Increase peak/off-peak fare differential | Maintain |
| 5. Adjust routes/schedules | Most likely maintain; possibly decrease. |
| 6. Use reserve fleet/school buses/ leased vehicles | Increase |
| 7. Increase express bus service | Increase |
| 8. Defer maintenance | Increase |
| 9. Use HOV lanes | Maintain |
| B. Reduce Market Scenario Costs | |
| 1. Reduce off-peak service | Reduce |
| 2. Reduce weekend/night service | Reduce |
| 3. Energy conservation techniques | Maintain |
| 4. Suspend work rules | Maintain |

* These actions are identified in Daniel Boyle, Transportation Energy Contingency Planning: Quantifying the Need for Transit Actions, Albany, January 1983.

various actions because the fuel availability/price conditions will restrict the choices only to those which involve a reduction in current services (VMT).

The alternatives for alleviating price/supply impacts of disruptions are now evaluated to determine if and to what degree they can expand the choice of actions to transit systems, to those necessitating current or increased VMT.

### 6.3.1 Current Fuel Procurement Procedures

This alternative requires transit systems to react to disruptions in ways which involve only a reduction in service. The actions selected must account for a reduction in VMT which, in the worst case, would be roughly equivalent to a reduction in the active transit fleet of a) between 5 and 45 percent during a minor disruption, and b) between 23 and 65 percent during a moderate disruption (with the ranges dependent upon either institutional or market conditions emerging; see Appendix C for method of derivation). In the unlikely instance of a transit system having a fixed-price fuel supply contract during a disruption, that system would be able to maintain pre-disruption VMT and be able to take appropriate actions. If transit systems supplemented allocated supplies (during institutional scenarios) with spot market purchases, this would still necessitate a significant reduction in VMT, only slightly less severe than the reductions identified above.

### 6.3.2 Federal Allocation

During institutional scenarios, the Federal Allocation alternative restores to transit systems, by definition, the choice of responding to contingency conditions with whatever actions are deemed appropriate. By devising a program that meets 100 percent of transit needs, services can either be increased, maintained or decreased according to the intentions of the particular transit systems. One possible limiting factor, however, would be if the Federal Allocation alternative were structured to guarantee 100 percent of predisruption use vs. 100 percent of disruption needs. In that case, actions involving increased service would not be available to transit systems.

During market scenarios, however, the Federal Allocation alternative does not address the financial needs of transit systems and therefore would only allow actions to be implemented which involve a reduction in service. The service reductions would be roughly equivalent to a two-fifths reduction in active buses during a minor disruption and a two-thirds reduction in active buses during a moderate disruption.

### 6.3.3 SPR Release and Directed Sales

Prior to 1990, an SPR auction would still require transit systems to consider only actions which involve a reduction in service. In the case of an SPR auction during a post-1990 minor disruption, where drawdown equals crude oil production loss, diesel fuel supply would be essentially unaffected and prices would likely remain unchanged. In post-1990 moderate disruptions, however, service reduction would still be a requirement. The service reductions necessary are less than those needed without SPR release, as Table 6.7 shows for the six case study transit systems (see Appendix C for method of derivation).

TABLE 6.7

NECESSARY SERVICE REDUCTIONS UNDER SPR RELEASE (AUCTION ONLY) ALTERNATIVE*

| System | Pre-Disruption Buses in Service | Number of Equivalent Buses Taken Out of Service During Minor Disruption, with:** | | | | Moderate Disruption, with:** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No SPR | SPR Now | SPR '86 | SPR '90 | No SPR | SPR Now | SPR '86 | SPR '90 |
| NJTC | 1800 | 97 | 55 | 28 | 0 | 409 | 380 | 362 | 328 |
| SEPTA | 1200 | 83 | 47 | 24 | 0 | 289 | 264 | 252 | 228 |
| WMATA | 1530 | 90 | 52 | 26 | 0 | 353 | 323 | 308 | 278 |
| CTA | 1930 | 138 | 77 | 39 | 0 | 468 | 425 | 405 | 367 |
| RTA | 475 | 34 | 19 | 10 | 0 | 113 | 105 | 100 | 90 |
| MTA | 540 | 37 | 22 | 11 | 0 | 130 | 119 | 113 | 103 |

* Only considers the institutional scenario, because price effects of SPR are not determined (See Table 6.4).

** SPR conservative drawdown results in fuel reduction as follows: Minor: w/o SPR = 7%; W. SPR now = 4%; SPR '86 = 2%; SPR '90 = 0.4%; Moderate: w/o SPR = 24%; w. SPR now = 22%; w. SPR '86 = 21%; w. SPR '90 = 19%.

If the directed sales option is instituted along with the auction, transit systems would have a) full choice restored among actions involving increased/maintained/reduced service during institutional scenarios, but b) only reduced-service actions available during market scenarios. The possibility of expanded service under institutional scenarios could be limited, however, if (as in the case of Federal Allocation) sales were directed to meet 100 percent of pre-disruption usage vs. 100 percent of disruption needs.

6.3.4 State Set-Aside

The effect of this alternative would be the same as that of Federal Allocation: a) full restoration of choice among actions involving increased/maintained/reduced service during institutional scenarios; b) only reduced-service actions available during market scenarios. The service reductions necessary during market scenarios would be roughly equivalent to a two-fifths reduction in active buses during a minor disruption and a two-thirds reduction during a moderate disruption (see Appendix C for derivation).

6.3.5 New Fuel Procurement Procedures

The effects of four particular options are reviewed.

1. SPR Auction Participant. In all probability, this would allow only reduced-service actions to be implemented. There is a possibility, however, that a transit system could successfully bid for all supplies needed under an institutional scenario, in which case a system would have all actions available to it.

2. Futures Market. Potentially, this option could restore full choice among actions to transit systems, since the market can be used to completely supplement supply or completely reduce fuel costs. Practically, however, the following is more likely: a) in the institutional scenario, full choice could be restored for a short time, since futures contracts are not necessarily available more than three to four months ahead; b) in the market scenario, only reduced-service actions could be implemented, since it is unlikely that a transit system could successfully make up in the future market all the additional costs present in the forward (i.e., normal delivery) market. The level of service reductions necessary would be less than that required under other alternatives where the additional funds made possible by the futures market are not available.

3. Contingency Inventory. In the mix of possible scenarios and disruption sizes, the contingency inventory would restore full choice among actions to transit systems in only one case, namely the minor disruption under institutional conditions. In all other cases, only reduced-service actions could be considered. Table 6.8 shows the level of service reductions necessary for the six case study transit systems (see Appendix C for derivation).

4. Spot Market. As with the Current Fuel Procurement alternative, the spot market can be utilized to purchase additional supplies during institutional scenarios. Since more funds would be available than under that alternative (due to futures market revenues, SPR auction revenues or large contingency funds), the level of fuel which can be purchased and VMT which

TABLE 6.8

NECESSARY SERVICE REDUCTIONS UNDER CONTINGENCY INVENTORY OPTION

| System | Pre-Disruption Buses in Service | Number of Equivalent Buses Taken Out of Service During Minor Disruption, Under: Institutional | | Market | | Moderate Disruption, Under: Institutional | | Market | |
|---|---|---|---|---|---|---|---|---|---|
| | | W/O Inv. | With Inv. | W/O Inv. | With Inv. | W/O Inv. | With Inv. | W/O Inv. | With Inv. |
| NJTC | 1800 | 97 | 0 | 133 | 123 | 409 | 328 | 315 | 290 |
| SEPTA | 1200 | 83 | 0 | 139 | 129 | 289 | 228 | 344 | 318 |
| WMATA | 1530 | 90 | 0 | 106 | 98 | 252 | 233 | 252 | 233 |
| CTA | 1930 | 138 | 0 | 130 | 121 | 468 | 367 | 310 | 286 |
| RTA | 475 | 34 | 0 | 36 | 34 | 113 | 90 | 88 | 81 |
| MTA | 540 | 37 | 0 | 41 | 38 | 130 | 103 | 98 | 91 |

can be restored is higher, but still not likely to be at pre-disruption levels. Thus, the actions available to transit systems under this option are most likely to be reduced-service actions, although there is a possibility that maintained-service actions could also be available.

### 6.3.6 Emergency Action Measures

Fares and subsidies offer the potential to restore full choice to transit systems among actions requiring increased, maintained or reduced service. Switching to diesel fuel #2, however, only allows reduced-service actions to be considered. The level of service reduction necessary is less than that required without the fuel switch, as Table 6.9 indicates (see Appendix C for derivation).

## 6.4 Secondary Impact Criteria Evaluation

The third criteria by which the alternatives are evaluated are their respective secondary impacts. Three impact areas are considered:

1. What will these alternatives cost?
2. What do the alternatives necessitate in terms of institutional changes?
3. What effects will the alternatives have on the oil market?

These evaluations appear below:

### 6.4.1 Evaluating the Costs of Alternatives

1. Current Fuel Procurement Procedures. There are no costs associated to this alternative per se; even without the threat of oil disruptions, transit systems would be required to procure fuel on a regular, contractual basis, utilizing the appropriate personnel, facilities, etc. All other alternatives, except for the New Fuel Procurement alternative, incorporate as given the functions and costs of this alternative as the basis from which most of the fuel required by transit systems will be obtained.

2. Federal Allocation. A Federal Allocation program designed exclusively for transit systems could be a relatively low cost alternative. A very few number of personnel (from U.S. DOE and UMTA) could administer the program, which necessitates the printing and distribution of certificates to the nation's 300-plus transit systems allowing them to purchase 100 percent of their needs. Some duties of the supervisory personnel would include not only production and distribution of certificates but general oversight of the program as well, in order to reduce problems (e.g., suppliers balking on delivery) and irregularities (e.g., transit systems selling unutilized supplies).

3. SPR Release and Directed Sales. The costs of SPR Release would be considerable: 1) organizing and administering a monthly auction process; 2) transferring the crude oil from the storage area to appropriate pipeline and barge transfer points; 3) transporting the crude oil to respective refineries. The first two cost components are the responsibility of the Federal government, although expected revenues from SPR sales will be large enough so that only a small portion would be necessary to pay for these operations. The third cost component is the responsibility of the purchaser, although the transportation cost of SPR fuel would be less than the transportation cost of imported fuel not forthcoming because of the disruption.

TABLE 6.9

NECESSARY SERVICE REDUCTIONS UNDER
TRANSIT SYSTEM SWITCH TO DIESEL FUEL #2

| | | Number of Equivalent Buses Taken Out of Service During | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pre-Disruption | Minor Disruption: | | | | Moderate Disruption: | | | |
| | Buses in | Institutional: | | Market: | | Institutional: | | Market: | |
| System | Service | With #1 | With #2 | With #1 | With #2 | With #1 | With #2 | With #1 | With #2 |
| NJTC | 1800 | 97 | 42 | 133 | 123 | 409 | 362 | 315 | 305 |
| SEPTA | 1200 | 83 | 36 | 139 | 129 | 289 | 252 | 344 | 333 |
| WMATA | 1530 | 90 | 39 | 106 | 98 | 353 | 308 | 252 | 244 |
| CTA | 1930 | 138 | 58 | 130 | 121 | 468 | 405 | 310 | 300 |
| RTA | 475 | 34 | 15 | 36 | 34 | 113 | 100 | 88 | 85 |
| MTA | 540 | 37 | 17 | 41 | 38 | 130 | 113 | 98 | 96 |

The costs of SPR directed sales would also be considerable, although significantly less than the cost of the auction process. The costs include: a) determining on a monthly basis how much is needed by each transit system (borne by the Federal government); b) transferring the fuel to distribution points (borne by the Federal government); c) transporting the fuel to appropriate refineries (borne by transit systems and refineries); d) transporting diesel fuel products to transit systems (borne by transit systems and refineries).

4. State Set-Aside. Set-aside program costs are grouped into two areas: 1) government costs (personnel, paperwork) and 2) fuel transfer costs. The latter costs are, in most cases, not expected to be significant, since normal supply chains are utilized to the greatest extent possible. Thus, for example, instead of a transit system receiving 90 percent of its needs delivered (as all other consumers would receive), the suppliers would deliver 100 percent of the system's needs. Only in occasional instances, when new suppliers might be directed to make deliveries to transit systems would additional costs occur (and be borne by supplier and transit system). In terms of government costs, the magnitude of those costs depends upon a) the number and amount of fuels set aside, b) the number of priority users and hardship cases to be served, c) the speed with which fuel should be reallocated,* and d) the reliance upon a centralized staff vs. "deputized" county government personnel.** In other words, the cost which may be substantial, is related to the size and the efficiency of the program and not to the transit element itself. That element would likely be a small part of the overall costs.

5. New Fuel Procurement Procedures. The costs of instituting many of these procedures would be significant (as compared to the costs of current fuel procurement procedures, Circa 1984), but it would be the expected intention that the revenues and/or savings eventually forthcoming from such actions as cooperative fuel purchasing and the futures market would more than compensate for these additional costs. The futures market is, after all, run on a margin basis where participants only have to commit a small portion (5-20 percent) of the contract's value up front. Thus if all transit systems purchased contracts to completely hedge against price or supply changes associated with the disruptions identified in Chapter 5, the up-front costs would be only a small portion of total contract value, as Table 6.10 indicates. Margins are subject to change, however, and transit systems would have to be prepared to increase their up-front payment on a daily basis.

The main costs of this alternative would be the 25-day contingency inventory. The costs are capital (storage facilities, fuel purchase) operating (maintaining the facility and fuel quality) and opportunity (using funds for other purposes). If managed in a manner responsive to economic conditions

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* Oil companies want states to reallocate set-aside fuel within the first two weeks of the month or else release the fuel to its original owners.

** In the State of Washington, a centralized staff handled all set-aside requests in 1979-1981; in New York, county civil defense coordinators assessed fuel needs and dispersed fuel as they saw fit.

TABLE 6.10

MARGIN COSTS OF ALL TRANSIT SYSTEMS
HEDGING AGAINST PRICE/SUPPLY CHANGES

| Hedging Strategy | Monthly # of Contracts Needed to Purchase | $ Value of Those Contracts ($1.00 Per Gallon) | Monthly Margin Costs of Contracts if Margin is: 5% | 20% |
|---|---|---|---|---|
| 1. Hedge against minor disruption allocation. | 57 (See Section 6.2.4, part 5 for derivation). | $ 2.39 million | $119,500 | $478,000 |
| 2. Hedge against moderate disruption allocation. | 211 (See Section 6.2.4, part 5 for derivation). | $ 8.86 million | $443,000 | $1.77 million |
| 3. Hedge against precipitous price increases. | 812 (See Section 6.2.5, part 5 for derivation). | $34.1 million | $1.71 million | $6.82 million |

(which means liquidating some portion of the inventory when diesel fuel prices drop or when interest rates increase too much, and then refilling when conditions change), the costs can be minimized (at some risk to effectiveness). On the other hand, a full 25-day inventory could be maintained continually if the Federal government subsidized transit systems (e.g., grants for storage facilities and low-cost fuel purchasing) as part of an overall effort to increase secondary and tertiary sector fuel inventory (11). Whether the Federal government subsidizes the cost or transit systems attempt to minimize the costs through economic adjustment of the inventory, this option is likely to be rather expensive; the purchase price of the fuel alone for all transit systems would be around $28 million (i.e., approximately 27,000 barrels used daily times $1 per gallon times 25-day supply). It is the "opportunity cost" of this amount which is a significant on-going cost if there is no disruption: the transit systems would have $28 million in operating capital tied up in this inventory. Further, there is the capital cost of the facilities and their maintenance costs to consider as cost components.

6. Economic Assistance Measures. The costs have already been identified as the funds necessary a) to purchase supplies from the spot market in the event of allocated deliveries, or b) to compensate for the significant price increases associated with market conditions. Those costs, which would allow transit systems to maintain current services, were identified, on a nationwide basis, as:

a. $3.5 million and $20.1 million monthly for spot market purchases during minor and moderate disruptions, respectively (see Section 6.2.4);

b. $26.3 million and $62.4 million monthly for total compensation during minor and moderate disruptions, respectively (see Section 6.2.5).

If all systems chose to implement transit actions that would increase VMT by 5 percent during minor disruptions and 10 percent during moderate disruptions, the costs would be approximately:

a. $6.6 million and $35.5 million monthly for spot market (minor and moderate, respectively) (see Appendix B for derivation);

b. $27.6 million and $68.6 million monthly for full compensation (minor and moderate, respectively) (see Appendix B for derivation).

Tables 6.11 and 6.12 indicate the impacts of deriving these costs from two key sources: increased fares or SPR-funded block grants. It is clear that fare increases would only be significant during market scenario, moderate disruptions: approximately a one-fifth increase would be necessary. In all other cases, the level of increase is much smaller. In fact the percentage increase in fares under all scenarios and disruptions is four to nine times less than the percentage increase in oil prices. As for using the SPR as a source for blockgrant subsidies to meet these added costs, no more than five percent of the expected revenue would need to be used for this purpose.

TABLE 6.11

FARE INCREASES NECESSARY TO FULLY MITIGATE AGAINST PRICE/SUPPLY IMPACTS OF DISRUPTIONS ON TRANSIT SYSTEMS*

| | | % Fare Increase Necessary to: | |
|---|---|---|---|
| Scenario | Disruption | Maintain Pre-Disruption VMT | Increase Pre-Disruption VMT* |
| Institutional | Minor | 1% | 2% |
| | Moderate | 6% | 10% |
| Market | Minor | 8% | 8% |
| | Moderate | 18% | 20% |

* Total monthly bus related revenues = $343 million, from National Urban Mass Transportation Statistics, Washington, D.C., November 1982.

** Increase VMT by 5% during minor disruption, 10% during moderate disruption.

TABLE 6.12

PORTION OF SPR REVENUES NECESSARY TO FULLY MITIGATE (THROUGH BLOCK GRANTS) AGAINST PRICE/ SUPPLY IMPACTS OF DISRUPTIONS ON TRANSIT SYSTEMS

| | | % SPR Revenues* Necessary to: | |
|---|---|---|---|
| Scenario | Disruption | Maintained Pre-Disruption VMT | Increase Pre-Disruption VMT** |
| Institutional | Minor | 1% | 2% |
| | Moderate | 5% | 7% |
| Market | Minor | 3% | 4% |
| | Moderate | 5% | 5% |

* Total SPR Monthly Revenues dependent on drawdown rate of 0.5 million barrels per day and auction price per barrel of $30 in institutional scenarios; $53 in market scenario, minor disruption; $85 in market scenario, moderate disruption.

** Increase VMT by 5% and 10% in minor and moderate disruptions, respectively.

### 6.4.2 Evaluating the Institutional Concerns of Alternatives

Three concerns are of interest here:

- What laws/regulations/programs need to be enacted?
- What level of coordination is necessary?
- Can the alternative be incorporated with other government actions during a disruption?

1. Current Fuel Procurement Procedures. These procedures exist, so that no new laws or programs need to be enacted nor is there any new coordinating activities that need to be performed. Furthermore, the alternative can be incorporated into any other government-related disruption actions.

2. Federal Allocation. Federal law would have to be enacted to create this alternative, along with necessary regulations. The level of necessary coordination is low: the Federal government passes on certificates allowing 100 percent of requirements to transit systems, who in turn pass them on to suppliers.

Federal Allocation does not comply with the 1980-84 Reagan Administration's intentions of maintaining a market-oriented, non-interventionist role during oil supply disruptions. It would be difficult to foresee strong support for this alternative within the Federal government, at least not until other alternatives were pursued. On the other hand, Federal Allocation would be an integral component of any effort to restore Federal price and allocation controls.

3. SPR Release and Directed Sales. Legislation exists for SPR drawdown and U.S. DOE has both issued proposed auction contracts as well as tested the drawdown/auction process. It has not, as yet, issued guidelines on the directed sales option. The level of coordination of many government, transit systems and oil suppliers for participation in either the auction or directed sales process would be high and relatively complex, probably beyond the scope of many current transit procurement offices.

SPR Release is an integral part of the Federal role in future disruptions and the directed sales component has the support of the 1980-84 Federal Administration. However, as has been stated previously, transit dependence upon this alternative during minor disruptions is questionable because of a stated reluctance to use the SPR during relatively small disruptions.

4. State Set-Aside. As previously stated, many states have created such programs and others already have the legislative power to do so through gubernatorial decision. Any effort to impose uniform characteristics among set-aside programs would require enactment of a Federal law. Coordination between transit systems and state energy officials administering the set-aside program must be high so that transit can receive its monthly requirements.

In principle, state set-aside can operate within a Federally deregulated environment (as long as the share of fuel controlled by the state is relatively low). As occurred in the 1970's, they have also can operated within a highly regulated environment.

5. New Fuel Procurement Procedures. States would have to grant transit systems the power to institute a number of these options. Many states, for instance, currently either restrict the extent to which local units of government can cooperatively purchase items or do not explicitly grant such authority (in which case co-op members could risk anti-trust actions by vendors) (12). In addition, states may have to grant permission for transit systems to participate in the futures market, SPR auction, joint contingency budgets or inventories, etc. Once authority is granted and such procedures are chosen, the centralized co-op procurement office becomes the focus of coordinated efforts among co-op members, oil suppliers and the Federal government.

This alternative mirrors the 1980-84 Reagan Administration's efforts to emphasize market responses to disruptions. It transforms the transit system from a public agency receiving fuel to an energy consumer competing with other consumers for both lower prices and more secure supply sources. Having achieved this status, however, does not put the transit system at a disadvantage if the Federal government reimposes regulatory control during a disruption. It simply acts like other consumers: following the market closely when it rules; utilizing government assistance when regulation returns.

6. Economic Assistance Measures. Federal legislation is necessary for block grants to be instituted; Federal or state regulatory code would have to be drawn up to guarantee that transit systems are recipients. Transit systems have well-developed channels for pursuing fare increases and service reductions, although as they have existed historically, they are not normally designed to grant temporary changes in fare or service. Therefore, the processes are generally relatively long and complex and not necessarily well-suited to disruption conditions. Thus, many transit systems would require a means of streamlining the fare and service change processes during disruptions, with the explicit guarantee made that the changes are temporary and linked to the disruption's duration.

The level of coordination among transit systems, local and state governments and public interest groups must be high to successfully institute fare increases, service changes and block grants utilization in a quick and effective manner.

This alternative fits within the current concerns and planning of the Federal government, although no authority exists to carry out any so-called revenue recycling actions other than a reduction in Federal income tax withholding rates. Fare increases and service reductions, however, may conflict with state efforts to maintain personal mobility and minimize economic hardship.

### 6.4.3 Evaluating Oil Market Impacts

1. Current Fuel Procurement Procedures. Continuation of these same procedures will have no impact on other oil product consumers or on oil product suppliers.

2. Federal Allocation. The amount of fuel being allocated away from other consumers to transit systems is not large relative to overall diesel fuel and distillate fuel use, and therefore, nationwide, this alternative is not likely to have more than a slight negative impact on other consumers. On a micro-scale basis, however, the alternative could cause a significant loss in fuel to some individual customers of a supplier which also serves a transit system.

The major impact of this alternative, however, will be that it will generate support for a larger priority user allocation system. Other municipal services, key economic sectors, small refiners, the poor and elderly, etc. will identify themselves along with transit systems as important priority users or hardship cases requiring additional fuel supplies. A direct consequence of this will be, on the one hand, a likely evaporation of support for a Federal Allocation alternative by oil suppliers (who might have supported a very limited program and the 1980-84 Reagan Administration). On the other hand, the uproar for special treatment may push Congress toward adoption of full-scale, re-regulatory actions for dealing with disruptions.

3. SPR Release. The SPR auction will, in general, benefit all oil consumers and suppliers, and, in particular, could significantly benefit and perhaps create a new force of suppliers who are not necessarily major pre-disruption suppliers but those with ready funds available during the disruption. The directed sales option will generate requests and political pressures from the same types of priority users and hardship cases attracted by the Federal Allocation alternative, with small, independent refiners generating the most concern. Whereas this level of interest by other parties may restrict the amount of fuel which eventually can be directed to transit systems, it has been previously noted that under the worst of conditions, transit systems would collectively require only 12 percent of directed sales fuel.

4. State Set-Aside. This alternative could have significant negative impacts on the supply of fuel to non-essential users/non-hardship users depending on a) the number and amount of fuels set-aside, and b) the length of time the state can hold on to set-aside fuels before they are restored to original owners. However, the impact of fuel allocated to transit systems in particular under set-aside is relatively small by comparison. As noted earlier, under the worst of conditions, only 13 percent of all set-aside fuel (assuming a program in every state) would be needed to meet monthly needs of transit systems.

5. New Fuel Procurement Procedures. Among the various options included within this alternative, one specifically would have a significant impact on the oil market, in particular upon oil suppliers. The cooperative fuel purchasing measure has the effect of reducing competition among diesel fuel suppliers since it a) decreases the number of separate contract bids in a given area and b) favors large suppliers over smaller ones. A widespread increase in cooperative fuel purchasing among transit and other local government agencies could further accelerate the concentration of diesel fuel bulk distribution into the hands of major oil companies and out of the hands of independent jobbers and distributors. A likely side-effect of this trend would also affect transit systems. Jobbers and distributors are the main participants in heating oil futures markets, since their middleman status requires considerable risk aversion through price protection. As their numbers decrease, the heating oil futures market could either a) decrease in importance (because fewer contracts would be traded), in which case the market becomes a less likely place for transit systems to get involved in, or b) change its composition in terms of the types of organizations participating, which could have positive or negative effects on transit participants depending upon what the composition eventually becomes.

6. Economic Assistance Measures. The block grant subsidy option will have no significant impact on other oil consumers, since it requires a very small portion of likely Federal funds available to support transit needs, leaving sufficient reserves available to assist other consumers. The switch to diesel fuel #2 takes advantage of a likely greater production of that fuel vs. #1 during disruptions but in itself would not significantly change #2 production or consumption.

## 6.5 Summarizing the Evaluation Process

Sections 6.2 through 6.4 evaluated all six alternatives against a comprehensive list of criteria. The bottom line results of these evaluations are summarized as follows:

### 6.5.1 Uncertainty

Seven separate areas of uncertainty criteria were used as a basis for evaluation. The critical criteria, however, however, are the price and supply impacts of disruptions. Figure 6.1 indicates the effectiveness of the various alternatives in relieving the range of supply and price impacts experienced by transit systems during minor and moderate disruptions. Clearly, subsidies and fare increases are the most effective while Current Fuel Procurement Procedures are the least effective (Block grant subsidies, however, would not be readily available in immediate disruptions).

No other alternatives can be classified as completely effective across the range of possible supply and price impacts. Federal Allocation, State Set-Aside, SPR Directed Sales eliminate shortages but offer no price relief. (The 25-Day Contingency Inventory also eliminates shortages but only during minor disruptions.) Other measures, specifically SPR Auction, Switch to Diesel Fuel #2 and New Fuels Procurement Procedures reduce the impacts of price and supply changes but do not eliminate these impacts.

Two other summary points can be made. New Fuel Procurement Procedures are worthwhile pursuing, especially since their use is controlled by transit systems (and not the uncertainties of other government actions) and are effective during non-disruption periods also. These procedures are not panaceas but they can significantly reduce adverse supply or price impacts under many possible disruption conditions.

Secondly, the SPR Release alternative has benefits, but the uncertainties of its use underslowly developing or minor disruptions has major limitations. (Besides, the supply benefits of the directed sales option are not met by the other alternatives as well.) Therefore, the alternative should not be considered as a direct transit assistance measure. If the auction process is implemented it will help transit systems, just as it will help all oil consumers.

### 6.5.2 Transit Service

Only the block grant subsidy and the fare increase measures allow, under any disruption conditions, transit systems increase, maintain or decrease services provided. If supply shortages arose (without precipitous price increases), then Federal Allocation, SPR Directed Sales and State Set-Aside

| ALTERNATIVES | MINOR DISRUPTION | | MODERATE DISRUPTION | |
| --- | --- | --- | --- | --- |
| | EFFECT OF ALTERNATIVES ON | | | |
| | PRICE IMPACTS | SUPPLY IMPACTS | PRICE IMPACTS | SUPPLY IMPACTS |
| 1. CURRENT PROCUREMENT | | | | |
| - CONTRACTS | ○ | ○ | ○ | ○ |
| - SPOT MKT. | ○ | ◑ | ○ | ◑ |
| 2. FED. ALLOCATION | ○ | ● | ○ | ● |
| 3. SPR RELEASE | | | | |
| - AUCTION | ◑ | ◑ | ◑ | ◑ |
| - DIRECT SALE | ○ | ● | ○ | ● |
| 4. STATE SET - ASIDE | ○ | ● | ○ | ● |
| 5. NEW PROCUREMENT | | | | |
| - FUTURES MKT. | ◑ | ◑ | ◑ | ◑ |
| - INVENTORY | ◑ | ● | ◑ | ◑ |
| - OTHER | ○ | ◑ | ○ | ◑ |
| 6. EMERGENCY ASSIST. | | | | |
| - SUBSIDIES | ● | ● | ● | ● |
| - FARE INCREASES | ● | ● | ● | ● |
| - SWITCH TO #2 | ◑ | ◑ | ◑ | ◑ |

○ Completely Ineffective ◑ Somewhat Effective ● Completely Effective

FIGURE 6.1

EFFECTIVENESS OF ALTERNATIVES AGAINST
KEY UNCERTAINTY CRITERIA

would do the same. A few alternatives under certain conditions would allow a maintaining or reduction in services; namely

- SPR Auction, in post-1990, minor disruptions only;

- Futures market deliveries, under institutional conditions only;

- Reasonable inventory, under minor disruption and institutional conditions.

All remaining alternatives necessitate service-reduction actions. The most severe service cuts would be necessary with the following measures and disruption conditions:

- Current Fuel Procurement, any conditions;
- Federal Allocation, market conditions;
- State Set-Aside, market conditions.

Less severe service reductions would be necessary under these measures and conditions:

- SPR Auction, other than the 1990 minor disruption;
- SPR Auction participant (under New Fuels Procurement);
- Futures market, market conditions;
- Reasonable inventory, market conditions or moderate disruption;
- Switch to Diesel #2, all conditions.

6.5.3 Secondary Impact

1. Cost Evaluation. Table 6.13 summarizes the costs of the alternatives. The lowest cost measures are maintaining Current Fuel Procurement Procedures and switching to diesel fuel #2; essentially they are no-cost measures. Federal Allocation is a very low cost alternative. Beyond these, costs are at a considerably higher level. State Set-Aside is a labor-intensive alternative but the transit component would probably be comparable to the cost of the Federal Allocation alternative. In addition, the relatively high costs of enacting SPR Release (auction and directed sales options), cooperative fuel purchasing and futures market entry should be less than either a) costs of deferred imports, or b) expected revenues.

The three most expensive measures are reasonable inventory, block grant subsidies and fare increases. The latter two would not represent a major drain on either Federal coffers or riders' income, however.

2. Institutional Evaluation. Figure 6.2 summarizes the institutional impacts of alternatives. Only the Current Fuel Procurement Procedures is free from institutional concerns. All other alternatives require either laws to be passed, or a high level of coordination among various parties, or both. Most are adaptable to various overall governmental responses to oil supply disruptions except for Federal Allocation and SPR Release in minor disruptions, which conflict with the stated market approach of the Federal government, and fare increases/service cuts, which conflict with state level objectives of managing disruptions.

TABLE 6.13

SUMMARY OF COST IMPACTS OF ALTERNATIVES

| Alternatives | Cost Ranking (1=cheapest, 6= most expensive | Comments |
|---|---|---|
| Current Fuel Procurement | 1 | No additional costs over those currently outlayed. |
| Federal Allocation | 2 | Simple program requiring minimal administration. |
| State Set-Aside | 3 | Costs of programs vary; transit component minor. |
| SPR Release and Directed Sales | 4 | Government costs met by revenues. Transportation costs $\leq$ transportation costs of lost imports. |
| New Fuel Procurement (notably inventory) | 5 | Fuel purchasing/futures market costs should be met by revenues. Inventory costs will be high, even if minimized. |
| Economic Assistance Measures (notably fare/ subsidy increase) | 6 | Impact of these costs on fares would generally be low. Impact on SPR revenues would be slight. Switch to #2 is no cost. |

| ALTERNATIVES | LEGAL AND REGULATORY STATUS | DEGREE OF COORDINATION |
|---|---|---|
| 1.CURRENT PROCUREMENT | ● | ● |
| 2.FED.ALLOCATION | ○ | ● |
| 3. SPR RELEASE | | |
| - AUCTION | ● | ○ |
| -DIRECT SALE | ● | ○ |
| 4. STATE SET- ASIDE | ● | ○ |
| 5.NEW PROCUREMENT | ○ | ○ |
| 6. EMERGENCY ASSIST. | | |
| - SUBSIDIES | ○ | ○ |
| -FARE INCREASES | ● | ○ |

● Requires little or no changes in current laws,regulations or operating procedures

○ Requires considerable changes in current laws,regulations or operating procedures

FIGURE 6.2

THE INSTITUTIONAL IMPACTS OF ALTERNATIVES

3. Oil Market Evaluation. No measure diverts a significant amount of fuel from other users. But the Federal Allocation alternative would appeal to so many other users that it severely jeoprodizes its acceptance as a useful measure.

Only cooperative fuel purchasing significantly affects oil suppliers and that in a negative way (i.e., harming small suppliers).

# CHAPTER 7

# IMPLEMENTING RECOMMENDED ALTERNATIVES

## 7.1 Recommended Actions

The Federal subsidy through the block grant mechanism is the most effective alternative proposed, according to the Uncertainty and Transit Service Evaluations performed. It is recommended as the cornerstone of a package of actions designed to aid transit systems during future oil supply disruptions. One of the significant benefits of the block grant action is that it is in complete accord with the unregulated approach to managing the overall impacts of supply disruptions. As previous chapters have shown, the unregulated, market approach of dealing with disruptions relies on the price mechanism as the best method of allocating supplies (whether prices rise quickly or slowly because of institutional constraints). The problems with the market approach are based on questions of equity: a) is it fair that those unable to afford oil supplies should suffer the most; and b) if deemed unfair, how can those hurt the most be assisted without interfering with the pricing mechanism? An obvious way of providing assistance is through direct monetary payments, of which block grant subsidies are a good example.

The Federal block grant action does have two problems associated with it, however. First, it is not currently available as of this writing (Circa 1983-84). Second, it is relatively expensive compared to other alternatives (although not compared to the funding available). The problems are addressed through the recommended use of other actions. If block grant mechanisms are not immediately available and disruptions cause precipitous price increases, then temporary fare increases should be implemented until those mechanisms are formulated. However, fare increases should be avoided in settings where shortages vs. prices are the disrupting factors. The actions which could be implemented instead of fare increases to deal with concerns can also be implemented to help lower the costs of eventual block grants. These actions are:

1. State Set-Aside. State Set-Aside programs should not be instituted for the sake of transit systems alone. But if for other reasons states establish set-aside programs which include distillate fuels, then transit systems should participate in them during institutional scenarios to lower block grant costs or avoid fare increases.

2. New Fuel Procurement Procedures. Transit systems should pursue cooperative fuel purchasing objectives and investigation and likely entry into the heating oil futures market. These measures, during disruptions, will provide cost savings and possible fuel supplies. This will reduce block grant costs. But also in non-disruption conditions, this alternative offers considerable cost savings possibilities. However, the reasonable (i.e., 25-day) inventory is not recommended for implementation.

Finally, for those transit systems currently using diesel fuel #1, they should switch to #2, which would reduce the necessary levels of block grants or fare increases.

At the same time, some actions are not recommended for further considerations. Those are the following:

1. Service Cutbacks. While this does directly respond to the problems which disruptions create, it conflicts with the basic purposes of providing transit service, especially during a time when automobile related mobility will be restrained.

2. Federal Allocation. State Set-Aside is substituted for this measure in the recommended package because of a number of interrelated reasons. First, Federal Allocation conflicts with current Federal energy policies and, therefore, would face resistance. Secondly, that resistance is likely to be intensified as the concept of a Federal Allocation program attracts many other preferential users and hardship cases to the cause of such a program. Third, state-level Set-Aside can be in concert with Federal objectives to allow states to make their own policies on disruption planning and is in concert with the types of actions and directions which many states intend to take.

3. SPR Directed Sales. State Set-Aside is substituted for this measure in the recommended package for two reasons. First, the likelihood that the SPR will not be used at all in minor disruptions restricts this measure's effectiveness. Second, this measure is simply more complex than the Set-Aside measure: 1) SPR Directed Sales requires coordination among transit systems, oil suppliers and the Federal government and necessitates refining or fuel trading agreements, since SPR reserves are crude oil only; 2) Set-Aside requires coordination only between states and transit systems in order to establish appropriate needs.

4. Reasonable Inventory. This is not recommended for two reasons. First, the cost of this measure is high. Second, its objectives can be met by other recommended actions: block grants, futures market, State Set-Aside.

## 7.2 Implementing Recommendations

Two extreme positions of implementing these recommended actions are a) through regulatory action and, alternatively, b) through incentives. A third position, which combines elements of the two, is the one recommended by this study. These are discussed in the sections below.

### 7.2.1 Implementing Alternatives Through Regulation

The following regulatory actions could be taken to ensure enactment of the recommended alternatives:

- Federally imposed regulation requiring the use of block grant subsidies for transit fuel needs.
- Federally mandated rules for state set-aside programs. One of those rules would require the state to use set-aside supplies to meet any transit system supply shortages prior to using Federal block grants for that purpose.

- Federally imposed (or even state authorized) regulation requiring that prior to having available the use of block grant funds for fuel needs, all transit systems using diesel fuel #1 would have to switch to #2.

- Federally imposed regulations on the fuel procurement activities of transit systems. These regulations would be stipulations for receiving normal UMTA operating subsidy funds under the current Section 9 (combined capital/operating grant) program created by the 1982 Surface Transportation Assistance Act. The regulations would require joint fuel purchasing with nearby transit firms.

The problems with these regulations are as follows:

- Requiring the use of block grant funds for certain activities is a contradiction of purposes. Block grants are proposed so as to allow states to make the decision of what is the best use of these funds.

- The Federal government in the early to mid-1980's is not inclined to impose regulations reminiscent of those existing in the 1970s, such as uniform set-aside programs. Even if they were so inclined, the requirement that set-aside fuel be used (in part) for a particular purpose is analogous to the above case: state controlled set-aside programs assume that states are better informed than the Federal government as to which consumers are most needy; it is a contradiction of this assumption for the Federal government to specify users of set-aside fuel.

- Some transit systems have long-term prejudices against the use of diesel fuel #2, sometimes stemming back to actual incidences of poor cold-start performance or exacerbated maintenance problems. In addition, some transit fuel suppliers may not have ready access to #2 supplies. All told, the requirement could cause transit systems to willingly or unwillingly forego block grant subsidies.

- It is probably unconstitutional for the Federal government to mandate how transit systems purchase their fuel, since it interferes with intra-state commerce and requires states to pass anti-trust immunity legislation. But even if it wasn't unconstitutional, mandating cooperative fuel purchasing does not automatically mean the benefits of such a measure (e.g., sophisticated purchasing techniques, futures market investigation, etc.) will necessarily accrue. Furthermore, such a regulation does not (nor could it) say anything about cooperative purchasing between transit systems and other, non-transit government agencies.

### 7.2.2 Implementing Alternatives Through Incentives

The following approaches could be taken as a means of enacting recommended alternatives:

- Block grant subsidies could be set up without any required users, but with a recommendation that transit systems be considered as top priority cases. However, it would be stipulated by Federal regulation that under normal circumstances, funds distributed to transit systems could only be used for fuel purchasing purposes (as described in Chapter 5). But if transit systems took other clearly defined steps as a means of saving costs (e.g., switched to diesel #2, purchased fuel cooperatively, used the heating oil futures market, etc.) then those systems would be allowed to take the block grant amount due for fuel purchases and apply it for other purposes (i.e., reduce non-fuel operating expenses incurred from expanded services).

- Information could be disbursed to State Energy Offices (through cooperative effort of USDOE and UMTA) explaining the larger benefits of using set-aside supplies (if such programs exist) for transit purposes (when shortages occur) and utilizing block grants for actual economic hardship cases.

- Rather than mandating diesel fuel #2, the block grant provisions (discussed above) along with a wider disbursement of information about the characteristics and operating experience of diesel fuel #2 would serve as a means of implementing this alternative while achieving block grant cost savings.

- Finally, the block grant provisions will also create a somewhat more favorable environment for New Fuel Procurement Procedures to be enacted. But the key here is neither the block grant provisions nor a regulatory stipulation. The key is to convince transit systems that this alternative is an important measure even (or, more accurately put, especially) during non-oil supply disruption periods.

The problems with these approaches are the following:

- Without a requirement that states channel block grant funds to transit systems, they may choose to allocate funds elsewhere.

- Throughout the 1970s, states established priorities and methods of disbursing set-aside fuel, for the most part excluding transit system considerations (due to Federal allocation rules specifically aiding transit systems). If set-asides are re-imposed, states may find it easier (from a bureaucratic and political viewpoint) to meet transit needs with block grants and other (better understood) needs than with set-aside supplies.

- Both the diesel #2 and New Fuel Procurement Procedures issues involve information-dissemination efforts in areas which UMTA has traditionally not shown considerable concern.

### 7.2.3 Recommended Means of Implementing Alternatives

The following actions are recommended to implement the package of alternatives for dealing with disruption impacts on transit systems.

1. Block Grants. These should specify their use for transit systems. That use should be mandated for fuel needs only, unless specified fuel procurement/cost savings measures have been implemented by transit systems.

In those cases, the funds which would have been available for fuel needs can be made available for other non-fuel operating costs, in particular to make up for added costs of increasing service. Furthermore, in the event of shortages, states would be required to make set-aside fuel available to transit systems (if the state has a set-aside program in place) before disbursing block grant funds to those systems.

2. State Set-Aside. Such programs should not be mandated or regulated by the Federal government for the purposes of assisting transit systems. The above recommendation would require their use over block grant funds only if such programs were in-place.

3. Switch to Diesel Fuel #2. It is recommended that UMTA fund research and education efforts whose intent is to clarify the operating, maintenance, air quality, cost and institutional impacts of switching from diesel fuel #1 to #2 for a short or long-term period. That effect should examine a) the findings of various research efforts published by the Society of Automotive Engineers, b) the experience of the nation's transit systems (e.g., WMATA) and c) the fuel supply implications among diesel fuel distributors. The relevance and impacts of switching from #1 to #2 as either a normal fuel procurement procedure or only as a disruption measure should be highlighted.

4. New Fuel Procurement Procedures. It is recommended that UMTA fund studies (the Service and Methods Demonstration or Transit Management Programs being good existing conduit for such studies) demonstrating the costs, benefits and various impacts of such procedures. Cooperative fuel purchasing demonstrations can be coordinated with the National Institute of Government Purchasing and APTA. Case study experience on the heating oil futures market (involving transit systems and other users) should be widely disseminated. Information should be aimed at three types of potential users within transit systems: fuel procurement offices, Comptroller's offices, and the general managers.

#### 7.2.4. Role of UMTA

UMTA's role under these recommendations would be an active one. In this context, it is recommended that UMTA join with USDOE's Office of Emergency Preparedness in the planning of a possible block grant subsidy program; in this effort, it should consider preparing an agenda based on the recommendation of this work that block grant financing is the one means by which the impacts of oil supply disruptions on transit systems can be mitigated a) despite vast uncertainty, b) in a manner which allows transit systems the flexibility to respond to mobility needs in various ways, c) at a cost which is only a fraction of block grant funding, and d) in a manner keeping with the basic Federal objectives of non-intervention in oil markets.

It is also strongly recommended that UMTA further the role it has established over the past several years in terms of disseminating information to transit systems about the future of energy contingency planning. That effort should now emphasize testing and evaluating actions (in particular those recommended in this work) which provide cost savings potential during non-disruption and disruption periods (as well as supply security during disruptions). Basically, UMTA should encourage actions initiated by transit systems that are cost-effective and institutionally feasible in an energy future filled with uncertainty.

# NOTES AND CITATIONS FOR THE CHAPTERS

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    c. Charles Goring, WMATA
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    e. Larry Bush, RTA
    f. Dave Riley, MTA

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   b. Steve Wang, American Refining Group.
   c. William Schlarb, ARCO.
   d. Donald Claus, Clauss Heating Oils, Inc.
   e. James Kahn, Jr. and A. Zustovich, Exxon Co., U.S.A.
   f. F.H. Boeke, Mobil Oil Corp.
   g. Ted Anderson, Shell Oil Co.
   h. Richard Clark, Sun Company, Inc.

2. Interviews were held with the following individuals:

   a. Dr. Michael Canes, Harry Bialek, Betty Anthony and Bill Rozette, American Petroleum Institute.
   b. Mark O. Decker, National Oil Jobbers Council.
   c. Ronald Winkler, Steve Minihan, Marshall Hoyler, Henry Jenkins-Smith, Myron Allen, Alan Simmons, Sam Bradley, U.S. Department of Energy (USDOE).
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# APPENDIX A

# BRIEF DESCRIPTION OF THE MARKET AND INSTITUTIONAL DISRUPTION MODELS

Introduction

The market and institutional scenarios presented in Chapter 5 are based on oil supply disruption models presented in two sources: Larry Johnson, et. al., "Economic Impacts of Petroleum Shortages and the Implications for the Freight Transportation Industry," presented at the 61st Annual Transportation Research Board Meeting, Washington, D.C., January 1982; and U.S. General Accounting Office (USGAO), Oil Supply Disruptions: Their Price and Economic Effects, Washington, D.C., May 30, 1983. In addition, telephone conversations were held with Christoper Sarricks of Argonne National Laboratories (and co-author of the Johnson paper), Bill Kruvant of USGAO and Mary Ann Kah of the U.S. Synthetic Fuels Corporation (two of the contributors to the USGAO report). The models which these works utilized are briefly described, followed by adjustments made by this author.

The Johnson Paper "Market" Model

This model is based on calibrating three distinct sub-models. First, the rather large and all-encompassing Data Resources, Inc. Quarterly Model of the U.S. Economy is employed. Crude oil price changes are traced through various wholesale and retail stages of pricing. The model is adjusted by the authors to account for disruption related price effects very quickly. A second model (unrelated to the purposes of this report) translates micro-economic indicators from the above model into changes of commodity shipment demand. The crucial third model (called NAFDEM, or the National Freight Demand Model) is essentially a mode choice model (logit-based) which takes freight demand changes and converts that into modal use estimations. But more importantly for the purposes of this report, NAFDEM is used to calibrate equilibrium diesel fuel price changes. The calibration process explicitly follows the market principles shown graphically in Figure 4.1b and described in Section 4.3.1 of this report: the new price will settle where the reduced fuel supply curve intersects the reduced fuel demand curve. It is also explicitly assumed that the price is likely to adjust to the new equilibrium level fully and immediately following the disruption, even though actual U.S. supplies may be unaffected for a few months.

The supply reductions described are assumed values, although they are all based on recent USDOE supply disruption scenarios.

The USGAO Report "Institutional" Model

USGAO actually reports on the results of three separate models, but the one of interest here is the so-called "GAO Model" based on principles and estimates from the model devised by Philip Verleger's Oil Markets in Turmoil, Ballinger, Cambridge, 1982, a source which is heavily referenced in this report. The GAO model is a simple model which calibrates values in seven equations over a number of monthly iterations. Spot market price changes are the driving force in this model. Spot market price changes are a function of the ratio of expected-to-actual production. If expected and actual production are equal, spot prices will not rise. A disruption is modelled by lowering actual production, raising the expected-to-actual production ratio and thus spot prices.

But what makes this an institutional model is that a) contract prices do not rise immediately but lag behind spot market prices; b) the price lag creates consumer stockpiling, which further exacerbates the expected-to-actual production ratio; and c) consumer prices and consumption are a function of contract prices. The price lag is a function of conservative pricing behavior by U.S. oil companies, due to anticipated government restrictions and conservative OPEC pricing behavior.

The supply reductions are assumed values, roughly equivalent to the cumulative production capacities of various Middle East nations.

Adjustments to These Models

Johnson "Market" Model. The equilibrium price changes are actual values predicated on a base case diesel fuel price of $1.50 per gallon. For the purposes of this report, these actual values are converted into percentage increases and applied to a more realistic 1983 price of bulk-purchased diesel fuel of $1.00 per gallon. This change does not violate the process used in the Johnson paper to estimate equilibrium prices.

Based on other assessments of the market reaction to supply disruptions, this report assumes implicitly (although the Johnson paper does not actually state) that shortages will not occur within this model; consumers who can afford the new higher prices will be able to obtain all that they need.

USGAO "Institutional" Model. The price changes are based on actual changes to heating oil with base prices varying between $1.09 and $1.13 per gallon. For this report, the heating oil price changes are converted to percentage increases for diesel fuel, based on a pre-disruption price of $1.00 per gallon. This change does not violate the process used in the GAO Model to estimate new prices, while diesel fuel changes do generally mirror heating fuel price changes.

The GAO Model bases production loss on the percent of production capacity actually utilized. Separate capacity utilization percentages are assumed. For the purposes of this report, the percent of free world capacity currently being used is the relevant value selected.

Finally, since the GAO model is particularly interested in showing price and economic impacts, it does not explicitly state what types of product shortages would be faced in the U.S., nor how these shortages would be distributed. It is the implicit assumption of this report that a) the shortages in diesel fuel will be equal to the U.S. supply loss (which in itself is assumed to drop on a percentage basis equal to the free world percentage decrease) plus the additional fuel stockpiling, and that b) the shortage will be distributed equally among all diesel fuel consumers throughout the U.S. In the first two months, there is no actual U.S. supply loss, only a decrease due to additional stockpiling. After that, the supply loss takes hold, and the available diesel fuel a) remains steady at 93 percent of normal deliveries during the minor disruption as stockpiling stabilizes, b) decreases from 77 percent to 74 percent during the moderate disruption as stockpiling continues to grow.

# APPENDIX B

## TABULAR RESULTS OF CHAPTER 5 FIGURES AND DERIVATION OF SOME CHAPTER 6 VALUES

1. Figures 5.1 and 5.2: Barrels (1000s) of Diesel Fuel Delivered Per Month

| System | No Disruption | Market Scenario* | Institutional Scenario:** 1 Month | 6 Month |
|---|---|---|---|---|
| NJTC | 33.7 | 33.7 | 33.0/31.3 | 31.3/25.6 |
| SEPTA | 26.0 | 26.0 | 25.5/24.2 | 24.2/19.8 |
| WMATA | 32.7 | 32.7 | 32.1/30.4 | 30.4/24.9 |
| CTA | 51.6 | 51.6 | 50.6/48.0 | 48.0/39.2 |
| RTA | 9.5 | 9.5 | 9.3/8.8 | 8.8/7.2 |
| MTA | 11.9 | 11.9 | 11.7/11.1 | 11.1/9.0 |

* Minor and moderate disruption.

** Minor/moderate disruption.

2. Figures 5.3 and 5.4: $(100,000s) Spent on Fuel Per Month

| System | No Disruption | Market Scenario* | Institutional Scenario:* 1 Month | 6 Month |
|---|---|---|---|---|
| NJTC | 14.2 | 25.1/40.2 | 14.2/14.2 | 13.7/12.4 |
| SEPTA | 10.9 | 19.1/30.6 | 10.9/10.9 | 10.4/9.4 |
| WMATA | 13.8 | 24.4/39.1 | 13.8/13.8 | 13.3/12.1 |
| CTA | 21.7 | 38.4/61.4 | 21.7/21.7 | 20.9/18.9 |
| RTA | 3.8 | 6.7/10.8 | 3.8/3.8 | 3.7/3.3 |
| MTA | 4.9 | 8.9/14.2 | 4.9/4.9 | 4.8/4.4 |

* Minor/moderate disruption.

3. Figures 5.6 through 5.9: Bus VMT (Millions) Per Month*

| System | No Disruption | Market Scenario** | Institutional Scenario:** 1 Month | 6 Month |
|---|---|---|---|---|
| NJTC | 9.3 | 5.3/3.3 | 9.2/8.8 | 8.8/7.2 |
| SEPTA | 2.9 | 1.6/1.0 | 2.8/2.7 | 2.7/2.2 |
| WMATA | 4.4 | 2.4/1.5 | 4.2/4.0 | 4.0/3.3 |
| CTA | 6.6 | 3.8/2.4 | 6.5/6.1 | 6.1/5.0 |
| RTA | 1.4 | 0.7/0.5 | 1.3/1.2 | 1.2/0.9 |
| MTA | 2.3 | 1.3/0.8 | 2.2/2.1 | 2.1/1.7 |

* Based on Gallon per VMT ratio of a) NJTC = 0.15; b) SEPTA = 0.38; c) WMATA = 0.31; d) CTA = 0.33; e) RTA = 0.29; and f) MTA = 0.22. Based on current conditions. These values are not assumed to change during disruptions. In reality, some decrease might occur as congestion could decrease during a disruption, increasing speeds.

** Minor/moderate disruption.

4. Figures 5.10 and 5.11: $(100,000s) Spent on Fuel Per Month*

| System | No Disruption | 5% Increase in VMT | 10% Increase in VMT |
|---|---|---|---|
| NJTC | 14.2 | 26.0 | 43.4 |
| SEPTA | 10.9 | 20.5 | 34.3 |
| WMATA | 13.8 | 26.2 | 43.9 |
| CTA | 21.7 | 40.5 | 67.9 |
| RTA | 3.8 | 7.5 | 12.5 |
| MTA | 4.9 | 9.4 | 15.8 |

* Based on same Gallon per VMT ratios as above.

* Gallons needed for 5 percent more VMT = 35.8 million.

* Gallons needed for 10 percent more VMT = 37.5 million.

- Institutional

  * Minor

    - 35.8 million - (31.4 million x .93) = 4.1 million gallons x $1.77 = $7.3 million - .7 million available budget = $6.6 million.

  * Moderate

    - 37.5 million - (31.4 million x .76) = 13.6 million gallons x $2.83 = $38.6 million - $3.1 million available budget = $35.5 million.

- Market

  * Minor

    - 35.8 million gallons x $0.77 = $27.6 million

  * Moderate

    - 37.5 million gallons x $1.83 = $68.6 million

5. Contingency Inventory and its Impacts Against Price Increases (See Section 6.2.5)

- Monthly diesel fuel consumed by all transit systems = 34.1 million gallons.

- Monthly costs during market scenario disruptions:

  * 34.1 million x $1.77 = $60.4 million (minor)

  * 34.1 million x $2.83 = $96.5 million (moderate)

- Monthly amount replaced by inventory = 34.1 million gallons x 7% = 2.4 million gallons, at $1 per gallon = $2.4 million.

- Savings:

  * $60.4 x .93 + $2.4 million = $58.6 million (minor)

  * $96.5 x .93 + $2.4 million = $92.1 million (moderate)

  * $1.8 million (3 percent) saved (minor)

  * $4.4 million (5 percent) saved (moderate)

6. <u>Block Grant Costs (See Sections 6.2.4 and 6.4.1)</u>

a. <u>Section 6.2.4</u>

- <u>Minor</u>:

  * 34.1 million gallons x 7 percent x $1.77 = $4.2 million

  * Minus available, unspent budget = $34.1 million x 2% = $0.7 million (see Section 5.3.3)

  * $4.2 - $0.7 = $3.5 million

- <u>Moderate</u>:

  * 34.1 million gallons x 24 percent x $2.83 = $23.2 million

  * Minus available, unspent budget = $34.1 million x 9 percent = $3.1 million (see Section 5.3.3)

  * $23.2 - $3.1 = $20.1 million

b. <u>Section 6.4.1</u>

- <u>Basics</u>

  * Monthly VMT all transit buses = 126.3 million.

  * Gallons per VMT all transit buses = 0.27.

  * Gallons needed for 5 percent more VMT = 35.8 million.

  * Gallons needed for 10 percent more VMT = 37.5 million.

- <u>Institutional</u>

  * Minor

    · 35.8 million - (31.4 million x .93) = 4.1 million gallons x $1.77 = $7.3 million - .7 million available budget = $6.6 million.

  * Moderate

    · 37.5 million - (31.4 million x .76) = 13.6 million gallons x $2.83 = $38.6 million - $3.1 million available budget = $35.5 million.

- <u>Market</u>

  * Minor

    · 35.8 million gallons x $0.77 = $27.6 million

  * Moderate

    · 37.5 million gallons x $1.83 = $68.6 million

# APPENDIX C

# THE EQUIVALENT BUSES CONCEPT

In Chapters 5 and 6, the concept of equivalent buses is introduced as a means of evaluating the impacts of oil supply disruptions upon services provided by a transit system. As Chapter 5 notes, it is a concept used only for the purposes of comparison among transit systems and elucidation of how serious service cutbacks can be as a result of diesel fuel price and supply changes. The concept is not intended to serve as a forecast or recommendation of how transit systems should deal with the need to cut services. Indeed, the options for reducing costs and services are boundless: e.g., cut all buses an equivalent amount, cut some more than others, remove buses from service, etc. The last option is the equivalent bus concept and obviously is only one of many methods.

The derivation of equivalent buses removed from service is different for the market vs. the institutional scenario. In the market scenario, cutbacks are necessary to reduce total operating costs. In the institutional scenario, cutbacks are necessary due to the unavailability of fuel. The derivations are described below.

- Market scenario - Using Table 5.4, monthly fuel costs are derived (i.e., monthly fuel use multiplied by $1 per gallon). Using UMTA Section 15 data (November 1982 published data) total operating costs per month are available for five of the six transit systems. For the RTA, a reasonable estimate is constructed based on the assumption that fuel costs are one-tenth of total operating costs. From Table 5.4, total buses in service is found, and total operating costs per in-service bus can be derived. As a result of minor and moderate disruptions, fuel costs rise substantially (i.e., 177 percent and 283 percent, respectively), while total operating costs rise to a lesser extent. Assuming that all operating costs can indeed be reduced, the number of equivalent buses that would have to be removed from service is equal to total additional costs divided by total operating costs per in-service bus. The buses removed from service represent conservative estimates, since some operating costs cannot be easily reduced (i.e., the so-called "flexible operating costs per in-service bus" is a lesser amount than the total operating cost figure, meaning that the number of buses to be removed is higher). Table 5.5 displays the results of this calculation.

- Institutional scenario - Table 5.4 shows the average monthly VMT per bus in active service. The effect of fuel supply allocation on the VMT which these systems provide (and which is used as a proxy for services provided) is shown in Figures 5.7 (minor disruption) and 5.9 (moderate disruption). The VMT reductions are then divided by VMT per bus to generate the number of equivalent buses which would be removed as a result of these changes. These values are shown in Table 5.6.

The concept is used again in Chapter 6 to indicate the transit service impacts of various alternatives. Specifically the concept is used as follows:

SPR Release. Table 6.7 shows the equivalent buses taken out of service as a result of the SPR Auction being the only alternative implemented (i.e. Institutional Scenario only). SPR drawdown reduces fuel shortages to the levels shown in the footnote to the table (taken from Table 6.3). These fuel reductions are then converted into VMT reduction using the fuel per VMT ratios shown in Appendix B. VMT reductions are in turn converted into equivalent buses taken out of service, using the VMT per bus in service values from Table 5.4.

Contingency Inventory. Table 6.8 shows the impacts of contingency inventory on equivalent bus reduction. Within institutional scenarios, contingency inventory reduces supply shortages to zero in minor disruptions and to 19 percent in moderate disruptions. The 19 percent shortfall is then converted to VMT and bus reductions. Refer to Table 6.5; the cost saving impacts under market conditions reduces only slightly the maximum level of cost reduction that would be necessary to maintain pre-disruption fuel budgets.

Switch to Diesel Fuel #2. Table 6.9 shows the service impacts of transit systems converting to diesel fuel #2. The switch allows transit systems to achieve cost savings (Refer to Table 6.5), and under institutional scenarios, to use the savings to purchase highpriced fuel on the spot market, which are then converted into VMT and equivalent bus service. Under market conditions, total operating cost increases are reduced slightly, translating into slightly fewer equivalent buses out of service.

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