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Report to the Honorable
Howard M. Metzenbaum, U.S. Senate

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INTERNATIONAL ENERGY AGENCY

Effectiveness of Members' Oil Stocks and Demand Restraint Measures

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The Honorable Howard M. Metzenbaum
United States Senate

Dear Senator Metzenbaum:

As you requested, we examined International Energy Agency (IEA) members' (1) compliance with the requirement to maintain emergency oil reserves equivalent to 90 days of oil imports, (2) the demand restraint measures they plan to employ during an oil supply disruption and (3) assessments of the effectiveness of those measures.

Background

The 1974 International Energy Program (IEP) Agreement, which created IEA, provides for an Emergency Oil Sharing System. Signatory countries are to maintain emergency reserves sufficient to sustain their consumption for at least 90 days with no net oil imports and establish measures for restraining oil demand and sharing oil supplies during supply disruptions.

The sharing system does not cover disruptions smaller than 7 percent of oil supplies. However, because smaller disruptions can cause considerable damage, members have agreed to develop a coordinated response to any disruption which the IEA Governing Board has determined threatens to cause severe economic harm.

Results in Brief

The IEA has made progress in recent years in improving its information about and evaluations of emergency oil stocks and demand restraint programs. However, important information is still lacking and uncertainties remain about the likely effectiveness of members' programs. For example, although most members technically comply with IEA's stock requirements, many countries are far short of 90 days of accessible emergency reserves, i.e., oil stocks established for emergency purposes and subject to government control during an emergency. In addition, uncertainty exists about the extent to which some countries will use emergency oil stocks in the event of an oil supply disruption.

Many IEA countries plan to use demand restraint measures as their principal response to an oil disruption. The United States is concerned about the effectiveness of such measures because of (1) the difficulty in reliably estimating consumption reductions that will result from their use

and (2) uncertainty about whether members have developed effective programs for implementing them and whether they could or would use them in a timely way during a disruption. In addition, questions remain about the cost effectiveness of demand restraint measures relative to emergency oil stocks.

Most Members Lack 90 Days of Accessible Emergency Oil Stocks

Although most member countries technically comply with IEA's 90-day stock requirement, many lack 90 days of accessible emergency oil stocks.

IEA consists of 21 member countries, 18 of which are net oil importers and thus required to hold emergency reserves. The other three countries export more oil than they import and thus the 90-day requirement does not apply to them. Three of the 18 net oil importing countries did not meet the 90-day requirement as of January 1988. However, meeting or exceeding the IEP reserve requirement is not a good indicator of IEA's or individual members' overall preparedness. The oil stocks that IEA counts in determining whether a member meets the reserve requirement includes a substantial amount of oil companies' minimum operating inventories which are needed to keep the industry's oil supply and distribution systems functioning smoothly and normally would not be available for consumption.

IEA also estimates accessible oil stocks which exclude the minimum operating requirement but still include some company commercial stocks that were not established to meet IEP emergency reserve requirements and that are not under direct government control. Thus, it is not certain whether all of these stocks would be made available for drawdown or would be drawn in a timely manner during an emergency.

Using IEA data, we estimated accessible emergency oil stocks. These are similar to accessible stocks but include only stocks set aside for IEA emergency purposes and exclude company minimum operating inventories. As such, they are subject to greater government control during an oil supply disruption. In January 1987, member countries collectively held 89 days of accessible oil stocks but only 76 days of accessible emergency oil stocks. Two members had no accessible emergency oil stocks and nine had 51 or fewer days of such stocks. (See app. II, p. 17.)

Recognizing that the IEP measure of emergency oil stocks exaggerates members' capabilities, the United States, in October 1986, proposed that IEA countries make a political commitment to hold at least 90 days of

accessible emergency oil stocks and that, to be counted as such, governments should be capable of controlling their drawdown in an emergency. The proposal received little support. One reason is the cost of financing additional emergency oil stocks. Another reason is that many IEA countries plan to rely on demand restraint measures for reducing oil consumption during a disruption as well as emergency oil stocks, whereas the United States essentially relies only on the latter.

Uncertainty Over Ability and Willingness to Use Emergency Oil Stocks

Emergency oil stocks cannot be counted on for effective use if member country governments do not exercise adequate control over them. Control depends on having legal authority and standby and tested mechanisms and procedures for implementing drawdown. Willingness to use stocks is also important. If countries go to the expense of establishing and holding the stocks but delay using or do not use them at all during an emergency, much of their potential benefit may be foregone.

Generally, in member countries which require the oil industry to hold emergency oil stocks, companies commingle mandatory stocks with their commercial inventories. The IEA Secretariat does not have complete information on how many of these countries have laws for penalizing companies which do not fulfill a mandatory requirement. Nor has the Secretariat systematically collected information on which members audit their companies to assess whether the proper amounts of mandated stocks exist and to make sure that such stocks are not being used to assist normal company operations.

The IEP Agreement does not specify when or how much oil stocks are to be drawn down by members during a disruption, but implicitly assumes that stockdraw will occur when it calculates the oil supply each country is entitled to.

The large majority of IEA members, until recently, have indicated they will rely on demand restraint as their principal response to an oil supply disruption. However, in April 1988, an IEA official told us this situation is changing, and many IEA members now contemplate using a mix of stockdraw and demand restraint measures for responding to an oil supply disruption. He noted that 15 members tested procedures and mechanisms for early stock drawdown in an IEA test conducted in early 1988. The exercise increased confidence in the ability of these countries to draw reserves, but did not necessarily indicate countries would do so during an emergency.

Effectiveness of Demand Restraint Approaches

The primary U.S. approach to demand restraint is reliance on market forces—allowing rising oil prices to reduce oil consumption. Ordinarily this would be supplemented by rapidly drawing down large amounts of SPR oil early in a crisis—as a partial substitute for demand restraint and as a means of preventing panic buying and to restrain increases in oil prices. The United States believes that demand restraint programs intended to reduce consumption independently of oil price increases cannot be counted on to work well in an emergency. Other countries' estimates of forecast reductions, as provided to the IEA, have not identified the extent to which reductions would be due to non-price measures or to rising oil prices.

It is important that members distinguish between reduced oil consumption expected from non-price demand restraint measures and reductions likely to occur in response to rising oil prices. If non-price measures are not implemented quickly or take a considerable time to become fully operational, oil prices will rise higher during the interim in response to greater demand for oil. Rapid and substantial oil price increases could lead to significant consumption reductions but have serious adverse impacts on economic performance. For example, the 1979 Iranian oil supply interruption caused crude oil prices to increase from $13 to $32 per barrel. The Organization for Economic Cooperation and Development estimated that by the end of 1981 the higher oil prices had resulted in a total loss in real income to its member countries of nearly $1 trillion.

The IEA Secretariat, following reviews of individual members' emergency response programs that were conducted between February 1984 and November 1986, concluded that most members' demand restraint programs generally appeared suitable to reduce oil consumption during oil supply disruptions. This conclusion was affirmed following an April 1987 IEA workshop on demand restraint. However, there are several important areas of uncertainty and controversy about demand restraint.

First, reliable estimates of consumption reductions due to demand restraint measures as opposed to price increases are difficult to develop. At best, determining the effectiveness of these measures is imprecise either before an oil supply disruption occurs, during it, or after it is over. In terms of forecasting savings, there is little actual experience to use as a guide since the Emergency Sharing System has never been activated and the estimate is impacted by variables—oil price, weather, business conditions—whose relationship to petroleum demand is only partially understood. According to an IEA official, the difficulties in

establishing accurate measures of consumption reductions due to restraints are well recognized, but it does not follow that the measures are ineffective. The United States, however, believes savings cannot be estimated with any degree of confidence.

Second, information is not available on how long it would take for members' various demand restraint measures to become fully operational. Except for the United States, all IEA countries plan to rely considerably on some form of government-directed demand restraint measures to reduce oil consumption. These typically include government persuasion, compulsory orders (e.g., restrictions on building temperatures, gasoline sales, etc.), and, if necessary, allocation or rationing. The timing and type of restraint used will impact the amount of reductions in consumption. If IEA members begin by implementing light-handed measures, such as temperature reductions, and then wait for a few months to see how well they work, data and decision lags could delay use of other measures which might have a more positive effect on consumption and oil prices.

Third, whether it makes more sense to use emergency stocks or demand restraint measures or to rely on a combination during a crisis depends on the relative cost effectiveness of the two approaches. The United States has urged other IEA countries to estimate the relative costs of employing their respective stocks and demand restraint measures. However, neither the countries nor the Secretariat have done so. Two reasons why they have not is that it could be burdensome and the analysis would require making important assumptions about key factors whose values cannot be known with confidence. These include the magnitude, length, and probability of disruptions and the price path of oil during disruptions. While it may be difficult to make such estimates, the benefit is that the results could help members to better judge whether their planned approaches are likely to be cost effective.

Agency Views

As requested, we did not obtain official agency comments on this report. However, we discussed the material in the report with IEA, Department of Energy, and State Department officials.

Departments of Energy and State officials agreed that members should distinguish between the effects of their non-price demand restraint measures and rising oil prices on oil consumption and estimate the relative costs and benefits of emergency oil stocks and demand restraint measures. The IEA Secretariat said that it might be useful to separate the

effects of demand restraint measures from oil prices but that it would be difficult to do so in practice.

With respect to both emergency oil stocks and demand restraint measures, Department of Energy officials told us that the IEA needs to examine more closely whether member countries have the necessary legal authorities, procedures, organizations, and capabilities in place and ready to go when a disruption occurs. They said the Secretariat needs experts to help it in assessing whether members are adequately prepared.

In a similar vein, State Department officials said the IEA needs to conduct more in-depth reviews of each country's emergency response programs, similar to the annual reviews that IEA conducts of each member country's policies and programs for reducing oil dependence over the medium and long run. They said that too much of the Secretariat's staff has been allocated to the medium/long-term reviews and not enough to the emergency response programs. State officials believe that such reviews should be held in each country rather than at IEA headquarters in Paris, should involve interaction with officials who have responsibility for various measures, and should include a careful examination of the manuals and other materials which would be used by any particular country in implementing its programs during an emergency.

Energy and State Department officials believed that IEA's 1988 test of members' capabilities for coordinating a response to an emergency had been a useful and successful exercise, but one could not conclude that members have adequate programs. It is necessary, they said, to get behind numbers on stated capabilities that members provided to the Secretariat during the test.

Appendices I through III provide more detailed information on the above matters.

As arranged with your office, we plan no further distribution of this report until 14 days from its issue date. At that time, we will send copies to cognizant congressional committees and to other interested parties and will make copies available to others upon request.

Major contributors to this report are listed in appendix IV.

Sincerely yours,

Allan I. Mendelowitz

Allan I. Mendelowitz, Director
Trade, Energy, and Finance Issues

Contents

Abbreviations

CRA	Charles River Associates
DOE	Department of Energy
EIA	Energy Information Administration
ESS	Emergency Sharing System
GAO	General Accounting Office
GDP	Gross Domestic Product
IEA	International Energy Agency
IEP	International Energy Program
MMB	Million Barrels
MMBD	Million Barrels Per Day
MOR	Minimum Operating Inventory Requirements
OECD	Organization for Economic Cooperation and Development
SPR	Strategic Petroleum Reserve

Introduction

Under the 1974 International Energy Program Agreement (IEP), countries which join the International Energy Agency (IEA) are required to maintain emergency reserves sufficient to sustain consumption for at least 90 days with no net imports.[1] They are also to establish standby demand restraint measures[2] for reducing oil consumption by 7 percent in a supply disruption equal to or in excess of 7 percent of oil supply and 10 percent in a supply disruption of 12 percent or greater. In principle, the IEP emergency reserves obligation can be met by oil stocks, fuel switching (i.e., switching to an alternative fuel, such as natural gas, where the capability exists), or standby oil production. However, most IEA members have little fuel switching capacity or standby oil production. Fuel switching can also be substituted for a demand restraint obligation. Oil stocks is the standard used to assess whether members meet the 90-day IEP emergency reserves requirement.

In July 1984 the IEA Governing Board decided that for any oil supply disruption which threatens to cause severe economic damage, members will coordinate early drawdown of IEP emergency oil stocks or take comparable actions through reducing demand or switching to alternative fuels. This decision stressed the importance of early action as a means of mitigating serious economic damage that could otherwise occur.

IEP emergency reserves and demand restraint measures are complementary approaches for offsetting lost oil supplies. In any specific oil supply disruption, the IEP assumes members would use IEP emergency reserves to offset that portion of an oil shortage not met by a demand restraint requirement. However, they may employ additional demand restraint in lieu of using the IEP emergency reserves. Similarly, members may substitute IEP emergency oil stocks for demand restraint—if the substituted stocks exceed the 90-day IEP emergency reserves requirement.

The relative importance that should be accorded oil stocks and demand restraint has been a subject of considerable debate within IEA. In fact, as part of the July 1984 Governing Board decision, members agreed to further examine (1) minimum operating stock requirements of each member and whether additional IEP emergency oil stocks are needed, (2) the effectiveness of different methods of holding stocks and problems which

[1]Net oil imports are calculated by subtracting oil exports from oil imports.

[2]Demand restraint approaches can include government voluntary efforts (e.g., public information programs to encourage reduced oil consumption), direct government intervention through compulsory orders (e.g., restrictions on gasoline sales/purchases and vehicle use), and government mandated allocation and rationing. IEA has also recognized reliance on market forces or rising oil prices as a measure for helping to reduce demand.

may occur in achieving effective stockdraw, (3) the economic impacts of serious oil supply disruptions on each member, (4) the likely effectiveness and costs and benefits of demand restraint measures for each member, and (5) the potential for short-term fuel switching.

Since then, the IEA has made significant progress on some of these issues. For example, each member surveyed its companies to secure a better estimate of minimum operating inventories; as a result, a better picture has emerged of the quality of the IEP emergency oil stocks. As another example, the IEA Secretariat collected and analyzed more complete information on members' demand restraint capabilities and various aspects of their IEP emergency reserves, including their IEP emergency oil stocks programs.

Objectives, Scope, and Methodology

Senator Howard Metzenbaum requested that we provide a status report on IEA member compliance with a requirement to maintain IEP emergency oil reserves equivalent to 90 days of oil imports and that we review the demand restraint measures that members plan to employ during an oil supply disruption and any assessments of the effectiveness of those measures.

We reviewed and analyzed IEA and Departments of Energy and State documents on the oil stocks and demand restraint issues. We interviewed officials of the Departments of Energy and State offices that directly coordinate international energy activities with the IEA and which are also responsible for United States preparedness to meet oil supply emergencies and disruptions. We also talked with representatives of the IEA Secretariat.

We reviewed the Department of Energy study entitled "Analysis of IEA Energy Emergency Preparedness," prepared for it in September 1986 by Charles River Associates, and studies commissioned by two other IEA member governments on the oil consumption reductions that their respective countries could achieve using demand restraint measures.

As you requested, we did not obtain official agency comments on this report. However, we did discuss the issues with Department of Energy and State officials and representatives of IEA. Their views have been incorporated in the report where appropriate.

Our audit work was conducted from December 1986 through June 1988, in accordance with generally accepted government auditing standards.

Emergency Oil Stocks

Oil stocks are the basic standard used to assess whether members meet their 90-day emergency reserve requirement. In this report oil stocks which qualify as IEP emergency reserves are referred to as IEP emergency oil stocks.

Of 21 IEA members,[1] 18 are currently net oil importers and 3 are net oil exporters—Canada, Norway, and the United Kingdom. The latter are not required to hold emergency reserves for IEP purposes. In 1987 their net exports equaled about 11 percent of the other member countries' total net oil imports.

According to the IEA, most members which are required to hold IEP emergency oil stocks mandate that oil companies maintain stocks to meet the obligation. These are called mandatory company stocks. In some cases the government holds all or part of a country's IEP stocks. In a few countries the government permits its oil companies to create a special private entity or association to hold part of the IEP stocks, and in a few countries the government has created public associations or corporations to hold such stocks.

In 1987 five members accounted for 84 percent of IEA members' aggregate oil imports: the United States (33.4%), Japan (23.7%), West Germany (12.5%), Italy (9.7%), and Spain (4.7%). Consequently, in combination, their programs can be expected to significantly affect the IEA's overall preparedness for disruptions.

Most Countries Technically Comply but Lack 90 Days of Accessible Emergency Oil Stocks

The IEP Agreement defines emergency oil stocks as crude oil, major products, and unfinished oils held in refinery tanks, bulk terminals, pipeline tankage, barges, intercoastal tankers, oil tankers in port, inland ship bunkers, storage tank bottoms, working stocks, and by large consumers as required by law or otherwise controlled by governments.[2] The total of such stocks, minus that portion "which can be technically determined as being absolutely unavailable in even the most severe emergency," can be credited toward each member's 90-day IEP emergency reserves requirement.

[1] Australia, Austria, Belgium, Canada, Denmark, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, and West Germany.

[2] Excluded are crude oil not yet produced, and crude oil, major products, and unfinished oils held in pipelines, rail tank cars, truck tank cars, seagoing ships' bunkers, service stations and retail stores, by other consumers, in tankers at sea, and as military stocks.

According to the Agreement, IEA would examine and report on criteria for the measurement of absolutely unavailable oil stocks but until a decision was reached on this matter, each member would reduce its total stocks by 10 percent in measuring its IEP emergency oil stocks. The IEA continues to use the 10 percent standard in measuring absolutely unavailable oil stocks.

Using the 10 percent method, most of the 18 members that are net oil importers currently meet or exceed the IEP 90-day emergency reserve requirement, but as of January 1988, 3 did not. One had only 42 days of IEP emergency oil stocks; the other 2 had 75 and 82 days, respectively. In combination, the 3 countries account for about 6 percent of the total IEP emergency reserve requirement.

However, we believe that the fact that most members meet or exceed the 90-day IEP requirement is not a reliable indicator of members' abilities to cope with disruptions, because the IEP's definition of emergency oil stocks includes substantial amounts of minimum operating inventory requirements (MORS). MORS are stocks needed to keep industry's oil supply and distribution systems functioning smoothly, and they normally would not be available for consumption.

MORS include "unavailable stocks" and "working stocks." Unavailable stocks are oil contained in continuous transportation systems, refinery equipment, and storage tank bottoms. They also include inventory in transit from domestic sources, such as barges, or tankers as well as fuel set aside for use within the system and crude oil lease stocks. None of this inventory can be used unless the facility or transportation mode is shut down and it is therefore classified as "unavailable."

Working stocks represent inventory over and above unavailable stocks. They are required to keep the distribution system functioning smoothly and avoid operating problems and run outs. They include a portion of the volumes needed to support the normal operating cycle of shipments and receipts as levels rise and fall in each tank when oil is delivered or removed. They also include oil for unavoidable but recurring operating interruptions and schedule changes as well as oil needed to facilitate blending of final products to required specification. Working stocks, for all practical purposes, are also unavailable for consumption without exposing the system to supply disruptions.

Using IEA information on member countries' MORS and other oil stocks data, we calculated accessible emergency oil stocks. We defined these to

include (1) mandatory company oil stocks, (2) oil stocks held by private entity or public stockholding associations, and (3) government oil stocks—all set aside for the purpose of helping countries meet the 90-day IEP emergency reserves requirement. Excluded from this definition are company MORs[3] and company stocks which are above MORs but not mandated by governments. The latter were excluded, since they are not under government control. During a disruption, a government may want its companies to draw down large amounts of stocks above minimum operating inventory levels. However, if oil prices are rapidly rising and future access to supply is in question, companies may prefer to hold onto their stocks.

As table II.1 shows, in aggregate, the 18 members that are net oil importers had about 76 days of accessible emergency oil stocks in January 1987. Three members had 186, 145, and 93 days, respectively. One member had almost 90 days, and 2 had about 80 days. However, 12 members had accessible emergency oil stocks of less than 60 days, and 10 of these had between zero and 50 days. In aggregate, the 12 members had close to 44 days of such stocks.

The 12 members accounted, in combination, for about 27 percent of IEA's net oil imports. If these countries do not have other programs capable of quickly reducing demand or otherwise offsetting oil consumption, their demand for oil could exert significant upward pressure on world oil prices during a disruption.

We compared the number of days of oil stock coverage for members using the definitions of IEP emergency oil stocks and our accessible emergency oil stock definition. The results showed that the IEP definition greatly exaggerates members' capabilities. For example, it credits the 18 net oil importer members with having 165 days of IEP emergency oil stocks in January 1987. But we calculated that those countries had only 76 days of accessible emergency oil stocks. Using the IEP definition, the United States was credited with having 263 days of emergency oil stocks. However, U.S. Strategic Petroleum Reserve (SPR) oil, the only stocks kept by the United States for IEP purposes, equaled only 93 days of U.S. net oil imports. Yet, without the SPR, the United States could have met the IEP requirement by almost two-fold because company oil stocks are included in the IEP definition.

[3]It may be possible to use some portion of MORs, but it would expose the system to disruption and adversely affect economic performance.

Comparison of GAO's Accessible Emergency Oil Stocks to IEA's Accessible Oil Stocks

In internal analyses, the IEA regularly calculates figures on accessible oil stocks. As defined by the IEA, accessible stocks[4] comprise government and public and private stockholding entity oil stocks established for IEP emergency purposes and all company-owned stocks that are above minimum operating levels. The latter includes stocks that governments mandate that the companies keep for IEP emergency reserves purposes and stocks which companies hold for commercial use.

The difference between our definition of accessible emergency oil stocks and the IEA's definition of accessible oil stocks is that we exclude company stocks above MORs which are not kept for IEP emergency purposes. According to an IEA official, the IEA does not distinguish between company stocks held voluntarily or pursuant to mandatory requirements, because it is extremely difficult to predict whether mandatory requirements should or would be reduced or what company stock behavior actually would be in an oil supply disruption. It cannot simply be assumed, he said, that companies either would not draw stocks they held voluntarily or would draw stocks down to mandatory levels. Therefore, the IEA's definition simply indicates the amount of stocks which could be drawn down without impairing normal supply operations.

Table II.2 compares figures on accessible emergency oil stocks as we defined them with accessible oil stocks as defined by IEA for January 1987. Under the IEA's broader definition, the number of days' stocks relative to the previous year's net oil imports is 89 days, or 17 percent greater than the 76 days under our narrower definition. The table shows that between January 1987 and January 1988 accessible stocks increased from 89 to 93 days of stocks.[5] The table also shows that even when the broader definition of accessible stocks is used, many countries are far short of 90 days of stocks and when the United States is excluded, other IEA members are considerably short, in aggregate, of 90 days of stocks.

Our analysis in this and the previous section is based on recent net oil import levels. It is quite possible that in future years oil imports will increase (see section on costs of stocks, p. 19). If this occurs, affected members will have to increase stocks simply to maintain the coverage which current levels provide.

[4]In June 1988, an IEA official informed us that "accessible stocks" was being replaced by the term "total stocks above MORs."

[5]Data for calculating accessible emergency oil stocks were not available for January 1988. Therefore, this comparison is not made.

able II.2: Comparison of Days of Net nports for Accessible Emergency tocks and Accessible Stocks[a]

Country	GAO accessible emergency oil stocks Jan. 1987	IEA accessible oil stocks Jan. 1987	IEA accessible oil stocks Jan. 1988
1. U.S.	93	126	119
2. A	80	80	90
3. B	46	90	188
4. C	36	85	95
5. D	80	80	86
6. E	51	51	44
7. F	17	48	58
8. G	59	59	66
9. H	186	187	230
10. I	145	144	154
11. J	88	87	81
12. K	49	49	57
13. L	50	49	62
14. M	44	44	50
15. N	50	51	49
16. O	26	26	18
17. P	0	11	17
18. Q	0	250	507
Average for IEA Net importers[b]	76	89	93
Average Except for the United States[b]	68	72	79

[a]For a discussion of the difference between accessible emergency stocks and accessible stocks, see p. 16.

[b]Weighted average for the group taking the aggregate stocks on hand for the specified period for the types of stock specified versus the collective previous year's daily net imports for the 18 members shown in the table.

Source: Compiled by GAO from IEA data.

.S. Proposal to ncrease Emergency)il Stocks

Recognizing that the IEP standard for measuring emergency reserves exaggerates members' capabilities, the United States has urged other members to increase the size and government control of emergency oil stocks. In October 1986, the United States proposed that all IEA members make a political commitment to hold "strategic" stocks equal to at least 90 days of net oil imports. By strategic stocks the United States basically meant accessible emergency oil stocks as used in this report.[6] A

[6]Strategic stocks were defined in U.S. government analyses as stocks either government-owned or controlled. The latter could include stocks held by stock-holding entities or company stocks directly controlled by governments.

political commitment would not require amendment of the IEP Agreement and thus might make it somewhat easier to secure the agreement of the other members; however, it would not carry the legal status of the Agreement.

IEA members have not adopted the U.S. proposal.[7] In the view of some members, it is not necessary for all countries to increase stock levels, because stocks are very costly for governments facing severe fiscal restraints, demand restraint is a suitable alternative, and improvement of demand restraint measures might be more appropriate and less costly. The United States is seen by some other members as needing large government-owned stocks to compensate for its lack of demand restraint measures. According to an IEA official, many countries now plan to employ both demand restraint measures and emergency oil stocks during a disruption. However, the United States plans to rely primarily on stocks. (See app. III.)

In 1987, the United States offered to conduct a seminar for other members showing how it has modeled optimum SPR size and drawdown rates. However, no seminar was held because other countries did not express sufficient interest. According to an IEA official, they were preoccupied with other IEA activities.

Although the U.S. proposal that members commit to hold 90 days of strategic stocks has not been approved, U.S. and IEA officials believe important progress has been made in the stocks area. The United States, West Germany, and Japan, which together account for about 70 percent of IEA's oil imports, each had at least 86 days of accessible oil stocks in January 1988. Several smaller countries had 90 days or more of accessible stocks. The United Kingdom, which maintains emergency reserves as a result of its participation in the European Community, had accessible oil stocks equal to about 40 days of its oil consumption.

In January 1988, Japan, West Germany, and two other members had about 232 million barrels (MMB) of government-owned emergency oil stocks. In addition, in West Germany and three other IEA countries, public or industry stockholding associations held, collectively, about 155 MMB of emergency oil stocks. These stocks may be generally considered more susceptible to government control than company-held stocks,

[7]The IEA supports actions taken by individual countries to increase their reserves beyond IEP requirements.

because they are physically separate from companies' operational commercial stocks.

In combination, the above government and association stocks equaled 387 MMB of oil. By way of comparison, on January 1, 1988, the U.S. SPR had about 540 MMB. However, the 387 MMB figure does not include any company oil stocks, including mandatory stocks above MORs, which oil companies in other IEA countries own. IEA estimated these at about 522 MMB as of January 1987.[8] If other IEA country governments were able to effectively control only one-third of this oil, total stocks under government control in the other IEA countries would approximate the size of the U.S. SPR.

Japan, West Germany, and the Netherlands have recently taken important steps to increase their overall stock holdings or the proportion of government-controlled stocks or both. Japan has plans to increase its government-owned stocks by about another 150 MMB. Other IEA countries are also considering creating or increasing government-controlled stocks.

In a few cases, countries have regressed. In 1986, New Zealand sold its national strategic petroleum reserve because of the high costs of holding emergency stocks and because it had completed a synthetic gasoline plant. Sweden has decided to eliminate the government's strategic petroleum reserve for meeting IEP requirements and to place the requirement for 90 days of emergency reserves on its petroleum industry.

Costs of Increasing Emergency Oil Stocks

Cost is a major reason why many IEA members are reluctant to commit to increasing their levels of emergency oil stocks. It is expensive to finance oil purchases and storage facilities for keeping the oil, and in many IEA countries reducing government budgets is a priority.

We estimated the cost to members to increase their accessible emergency oil stocks to reach 90 days of net imports. The reference point for calculating the required buildup is stock levels as of January 1, 1987. We estimated the cost to acquire the oil and storage facilities, and the annual holding cost for the additional oil once the buildup had been accomplished. For the purpose of both estimates, we assumed members

[8]The IEA did not separate data for company mandatory oil stocks from total company stocks for January 1988.

acquired the crude oil[9] at $20.64 per barrel. This is an average of world price projections for a 5-year period made by the U.S. Energy Information Administration (EIA).[10]

We defined acquisition cost as capital outlays to buy the oil and to buy or build storage facilities. As table II.1 shows, 15 members had less than 90 days of accessible emergency oil stocks in early 1987. In the aggregate, they were short 289 MMB. We estimated the cost to acquire this much oil and related storage facilities[11] at $7.5 billion. If the oil were acquired in one year, the per capita cost across the affected countries ranges between $1.89 to $66.41. The acquisition costs, however, could be spread out by purchasing the oil over several years, minimizing any price increases that might occur in a single year purchase scenario.

To estimate the cost of buying or building storage facilities, we used information supplied by members to the IEA concerning their preferred way for storing oil and costs to do so. Since the latter involved 1984 data, we estimated what the 1986 data would be by increasing the earlier data by the increase in the consumer price indices that took place between 1984 and 1986.

The cost of holding the stocks includes the annual imputed interest on the value of the oil and of any storage capacity bought or built to hold the oil, depreciation on storage capacity, and operating costs. The cost to lease oil storage facilities was used for those members that indicated they preferred this approach. Long-term government bond yields were used to measure interest costs. Country data on the cost to buy, build, or lease storage space and on annual operating costs were updated to 1986.

The aggregate annual holding costs to the 15 members, for the additional oil needed to reach 90 days of accessible emergency stocks, when fully acquired and stored, was estimated at $1.5 billion. As an indication of the burden to individual countries, we calculated per capita costs to

[9]Nearly all countries indicated to the IEA that they would store crude oil rather than oil products.

[10]Annual Energy Outlook 1986 With Projections to 2000. Our estimated cost is an average of EIA's projections of high world oil prices to 1990. EIA had also projected prices for a low and base case scenario, but at the time we made our estimate, the actual world price—$17.00—was higher than the low and base case projections. We therefore chose the price projections for the high case scenario. Of course, it should be recognized that any price projection or forecast is subject to substantial uncertainty. To put the $20.64 price per barrel in perspective, the actual average world crude price during the first quarter of 1988 was about $16.30 per barrel.

[11]Ten members indicated they would lease facilities. Leasing costs are not included in acquisition cost. Two members said they would use existing facilities and three would build new facilities.

each member and how much gasoline prices would have to be increased if a tax on gasoline were used to finance annual holding costs. Of course, burden could be analyzed from a variety of perspectives. For example, countries which plan on using demand restraint measures as well as emergency stocks would probably contend that the burden of the former should also be considered. Similarly, oil stocks could be financed in many ways; the United States finances its SPR out of general federal revenues.

The average annual per capita cost to hold the additional stocks for the 15 members was estimated at $3.65. However, the range across the countries of such costs is considerable, from a low of $0.23 to a high of $11.92 per capita. Even so, 9 of 15 members could finance the costs by adding a gasoline tax that in turn would increase gasoline prices by 2 percent or less.[12] Two countries would require price increases of between 2 and 4 percent and three would require increases between 4 and 5 percent.[13] (Data on gasoline prices were not available for one country.) The price increase would be smaller if a tax were placed on all oil products.

To provide further perspective, we compared the above holding cost with the cost to the United States of increasing the SPR to 750 MMB. An SPR increase of 238 MMB[14] would have an annual holding cost of $0.6 billion. The annual per capita cost would be $2.53; if it were financed by a gasoline tax, it would require a 0.6 percent increase in gasoline prices.

The degree of protection which the SPR additions will provide in future years depends on what happens to oil imports. According to the Department of Energy March 1987 Energy Security study, U.S. net oil imports in the mid-1990s could range between 8 to 10 million barrels per day (MMBD). That would be an increase over the 1987 level of about 6 MMBD. Given this range, a 750-MMB SPR would equal at most 94 days of net imports and possibly as few as 75 days.

[12]We used Organization for Economic Cooperation and Development (OECD) 1st quarter 1987 data on gasoline prices in calculating these results.

[13]The price of gasoline in most other IEA members is substantially higher than in the United States, partly because other countries impose higher taxes. During the first quarter of 1987, the average price per gallon in 19 IEA countries was 2.6 times as great as the U.S. price.

[14]Based on an SPR of 512 MMB of oil as of Jan. 1, 1987. This is the reference date we used for estimating by how much other countries would have to increase their oil stocks to attain 90 days of accessible emergency oil stocks.

The Energy Security study estimated that oil imports for OECD countries other than the United States could range between 12 to 15 MMBD by 1995, as compared with about 11.9 MMBD in 1987.[15] Although 15 MMBD would represent a 26-percent increase, it would not be nearly as much compared with U.S. imports growing to 10 MMBD (a 67 percent increase).

Questions About Whether Some Countries Can Effectively Control Drawdown of Their Emergency Oil Stocks

Having adequate oil stocks is important, but their value also depends on the ability of member governments to control them in an oil supply disruption, especially in the early stages of a disruption when there may be greater danger of markets overreacting.

In early 1988, IEA countries conducted a test of the procedures and mechanisms that each would use to implement various emergency response measures. Fifteen members simulated drawdown of emergency oil stocks. An IEA official told us that as a result of the test and reviews of member country measures made between October 1987 and February 1988 members are better prepared to engage in effective drawdown of emergency oil stocks. This progress notwithstanding, we found that areas of uncertainty still remain.

According to the Secretariat, it is generally agreed that a government's ability to influence drawdown of emergency oil stocks is more limited in the case of company-owned mandatory stocks. Yet, as discussed earlier, most IEA members depend on oil companies to maintain part or all of the oil stocks needed to meet their IEP requirements. In some countries, companies bear all the added costs associated with meeting this requirement; in others, governments provide some financial support.

Eighteen members (including two net oil exporters) have statutory power to mandate that oil companies maintain stocks; however, four members (including one net oil exporter) do not use that authority. Generally, where mandatory requirements exist, companies commingle mandatory stocks with their commercial inventories. According to the IEA Secretariat, it is very difficult to distinguish the commercial portion of company stocks from the mandated portion.

For those members which require companies to keep emergency stocks, the Secretariat does not have complete information on how many have

[15]Twenty-one of 24 OECD countries belong to the IEA. The only major OECD country which does not belong is France, but it is linked to the IEA by its membership in the European Community.

laws that penalize companies which do not fulfill mandatory requirements. According to its records, 8 of the 14 members that have mandatory company oil stocks in force stipulate a penalty for non-fulfillment of the stockholding requirement. The Secretariat does not have information on the other 6. Also, the Secretariat has not systematically collected information on which members audit their companies to assess whether the proper amounts of mandated stocks exist and are not being used to assist normal company operations.

During a disruption, member governments can encourage companies to draw stocks. Where mandatory stock requirements exist, governments can facilitate drawdown by eliminating or reducing the requirements, or if legal authority exists, by ordering companies to draw down stocks. However, simply reducing requirements will not guarantee that all or even most companies will actually draw down their emergency stocks or do so effectively. Companies whose supply is significantly disrupted may use their emergency stocks, but companies not so affected may choose to keep them to protect their supply positions or in anticipation of future price rises. Although the latter companies may be in a position to sell stocks at a substantial profit, their calculations must balance possible gains against the (1) future replacement costs should the disruption continue and they themselves later need the oil and (2) cost of rebuilding the stocks at the end of the disruption when governments are likely to re-impose compulsory stock levels.

The United States said it believes that company stocks cannot be counted on in the event of an oil supply disruption because companies will tend to react to higher oil prices by building rather than drawing down oil stocks. Consequently, it has urged other IEA members to build government-owned stocks. At a minimum, the United States has said that other members must exercise effective control over company mandatory stocks.

According to an IEA official, while it may be generally true that a government's ability to influence stockdraw is more limited in the case of company-owned emergency stocks, governments can influence the use of company-owned stocks through legal or administrative requirements and financial incentives. Examples of the latter are where company emergency oil stocks are subsidized or partly financed by government loans or guarantees.

According to the IEA, ten of the 13 IEA net oil importing members which require companies to hold emergency oil stocks have authority to direct

companies to draw stocks during an emergency. The others can only encourage companies to physically release stocks and facilitate this by relaxing the mandate on the amount of stocks that companies must hold. The former include Japan and West Germany, which together account for a large share of the IEA's net oil imports. In addition, the United Kingdom, a net oil exporter, can direct its companies to draw stocks in an emergency. Our analysis of IEA data shows these three countries have authority to direct drawdown of about 300 MMB of company oil stocks that are above MOR levels.

The United States has done far more than any other IEA country to establish government stocks. In January 1988, SPR oil equaled about 90 days of 1987 net oil imports. Only four other IEA countries had government stocks for IEP purposes in January 1988;[16] these stocks ranged between 3 and 38 days. For IEA oil importing countries in aggregate, excluding the United States, government stocks accounted for only 19 days of 1987 net oil imports.

Four IEA countries have public or private stockholding associations for holding emergency oil stocks. In January 1988, their stocks ranged between 12 to 112 days of their respective 1987 net oil imports. For IEA oil importing countries in aggregate and excluding the United States, association oil stocks accounted for only 13 days of 1987 net oil imports.

In January 1988, seven of the eight member countries which had government or association stocks also mandated that their oil companies hold stocks for IEP emergency purposes. Another six members, which had no government or association stocks, required their oil companies to hold emergency stocks. Four of the net oil importers had no government or association stocks and did not require their companies to hold stocks for IEP emergency purposes.

[16]The information and figures reported in this and the next two paragraphs differ from those reported in table II.1, since the latter are based on January 1987 stock levels.

Demand Restraint Effectiveness

The primary U.S. approach to demand restraint is reliance on market forces or rising oil prices to stimulate reduced oil consumption, ordinarily supplemented by rapidly drawing down large amounts of SPR oil early in an oil supply disruption as a partial substitute for demand restraint.[1] The United States also favors early drawdown of IEP emergency oil stocks for disruptions that are not big enough to trigger the Emergency Sharing System (ESS) but which threaten to cause severe economic damage.

Through fiscal year 1987, the United States had spent more than $18 billion in establishing an SPR of about 540 MMB.[2] This reserve is a major resource for use in an oil supply disruption. For example, the United States could draw as much as 3.1 MMBD during the first 3 months of a disruption, 2.4 MMBD during the 4th month, and 1 MMBD in the 5th and 6th months. At these rates, total drawdown would equal about 416 MMB and the average drawdown rate would be 2.3 MMBD. That would represent nearly 14 percent of U.S. oil consumption (1987 figures), far above a 10 percent demand restraint obligation which is the maximum that IEA members would expect to incur during a serious world oil supply disruption. If the United States drew only 1.2 MMBD, that would represent 7 percent of U.S. oil consumption,[3] sufficient to meet the minimum demand restraint obligation that could apply when the ESS is activated.

The United States is concerned that use of demand restraint measures may promote a shortage mentality, with adverse impacts on already short supplies. It believes that if people fear oil supplies are insufficient, they may rush to accumulate and hoard supply and such behavior would increase demand and drive oil prices higher. The United States notes that in the 1979 Iranian disruption, increases in inventory accounted for most of the worldwide supply shortfall.

One expert on world oil inventories has concluded that a disruption is likely to trigger a stock buildup of monumental proportions. After

[1]When a member substitutes drawdown of IEP emergency oil stocks for demand restraint, it is supposed to draw only on stocks in excess of its IEP emergency reserve commitment. If IEP emergency oil stocks were defined by the IEA to include only accessible emergency oil stocks (as defined in app. II), the United States would be limited in the amount of SPR oil it could substitute for demand restraint. However, as long as the definition includes a substantial portion of industry's MORs, there seems to be no practical limit on the use of SPR oil for demand restraint.

[2]See our September 1987 report, Oil Reserves: An Analysis of Costs (GAO/RCED-87-204FS) p. 1.

[3]In March 1987, DOE projected that U.S. oil consumption in 1995 might be as high as 17.7 MMBD. If the United States were to draw down the SPR at a rate of 1.2 MMBD, that would equal 7 percent of consumption and 2.3 MMBD would represent nearly 13 percent of consumption.

adjusting for seasonal stock changes, he estimated there could be a surge stock build by the petroleum distribution system and oil consumers ranging between 5 to 8 MMBD over a 3-month period. If the disruption occurred in August or September, the surge could be larger by several MMBD.[4] To put these numbers in perspective, surge stockbuilding of 8 MMBD for 3 months would equal about 720 MMB of oil. If IEA countries had held emergency oil stocks in 1987 equal to their previous year's net oil imports, the stockpile would have equalled about 1,580 MMB of oil. Thus, it can be seen that if IEA countries agreed to use their emergency oil stocks as a response to a disruption, it is possible that a substantial portion of the drawn stocks might be put back into industry and consumer inventories rather than being used as a direct replacement for disrupted oil supplies.

All IEA members, except the United States, plan to rely considerably on some form of government-directed demand restraint to help reduce consumer oil demand. Of the 20 other members, 18 have persuasion (e.g., public information programs to encourage consumers and industry to reduce oil consumption) and compulsory orders (e.g., restrictions on gasoline sales/purchases and vehicle use), 20 have allocation programs, and 19 have said they have or would consider establishing rationing[5] measures as part of their programs to reduce demand. Ten members indicated they may employ price controls.

Most IEA members feel that government intervention is necessary to cope with oil supply disruptions in an orderly manner and to minimize a disruption's impact on economic and social life. The economic optimum allocation of oil is not perceived as necessarily being the social optimum. And, opinions differ as to whether demand restraint measures reduce the losses resulting from an oil supply disruption or, as the United States says, exacerbate losses because of economic inefficiencies in the allocation process. As an example of the latter, oil may be allocated to some users who do not value it as highly as other users who would be willing to pay more for the resource.

[4]Edward N. Krapels, "Growing Influence of Oil Stocks," Petroleum Economist, June, 1983, Vol. L, No. 6, pp. 211-215.

[5]Allocation distributes an oil shortfall among energy consumers, normally by government intervention. It can be accomplished in various ways. For example, crude oil can be allocated among refiners and regions of the country. Rationing is a form of allocation which extends to the end user. In this case the government restricts what consumers can buy.

Effectiveness of Demand Restraint Measures

Following a review of individual members' emergency response programs, conducted during February 1984 to November 1986, the IEA Secretariat concluded that most members' demand restraint programs generally appeared suitable to reduce oil consumption during oil supply disruptions. And, following an April 1987 workshop on demand restraint, it reported that most members consider demand restraint measures effective for coping with disruptions. However, there are several important areas of uncertainty and controversy about demand restraint.

First, can reliable estimates be made of consumption reductions that demand restraint measures could achieve and have they been made so that IEA members can have confidence in the results? Second, do members have non-price demand restraint measures which can be quickly implemented in the early stages of a supply disruption to reduce consumption by meaningful amounts and thus offset lost oil supplies? Third, what are the costs and benefits of such demand restraint measures relative to alternative approaches for offsetting lost oil supplies, including relying on rising oil prices or drawing down emergency oil stocks?

Difficulties in Reliably Estimating Consumption Reductions Due to Demand Restraint Measures

At best, determining the effectiveness of demand restraint measures is imprecise and difficult. This is the case if effectiveness is being estimated before an oil supply disruption occurs, during it, or after it is over. There are several reasons for this.

In terms of forecasting savings, there is little actual experience to use as a guide. The ESS has never been activated during a real disruption. Some members had demand restraint programs before IEA was established, but they were applied only to a degree during the 1973-74 Arab oil embargo. The 1979 Iranian oil supply interruption was not big enough to trigger the system; nonetheless, members agreed to reduce anticipated consumption by 5 percent by the end of 1979. However, the agreement was voluntary, and many members did not implement demand restraint measures or did so only on a limited basis. Except for a few, including the United States, countries reduced consumption by an average of only 2.6 percent. The U.S. reduction was mainly due to shortages rather than demand restraint measures.

Further, it is difficult to estimate demand restraint savings because oil prices, weather, business conditions, and other factors affect petroleum demand. The underlying relationships between these factors and oil

demand are only partially understood, and timely data on them would not generally be available during a disruption.

Problems arise in trying to monitor demand during an oil supply disruption. The Department of Energy (DOE) has noted that because of practical difficulties in measuring consumer purchases directly, virtually all of the data systems designed or used by IEA members to monitor supply and demand measure consumption indirectly. And, time lags in collecting data limit the usefulness of monitoring consumption.

If members cannot adequately monitor demand restraint effectiveness during a severe oil supply disruption, the IEA's ability to cope with the disruption could be weakened. For example, if data were available that showed that a measure was not working well in a particular member country, its government could possibly take corrective action. In the absence of reliable and timely data, such actions may be delayed or never taken.

According to an IEA official, difficulties in establishing accurate estimates of consumption reductions that are attributable to demand restraint measures are well recognized but it does not follow that the measures are ineffective. He said that the quantitative effects of a number of demand restraint measures can be estimated reasonably well apart from the effects of rising oil prices. He noted that more accurate assessment and improvement of effectiveness are a constant concern to the Secretariat, but that a detailed study would also be costly and time-consuming; it would be necessary to consider many factors that would be hard to quantify, especially as a theoretical matter absent the circumstances of an actual oil supply disruption.

Controversy Over Members' Estimated Consumption Reductions Due to Demand Restraint Measures

Table III.1 shows the number of IEA members which have various demand restraint measures and how long it would take to introduce them. The United States is not included because it does not have an established set of demand restraint measures except for oil used by the federal government and those measures would reduce consumption by only a small amount. As the table shows, nearly all members have each of the measures and all members have allocation programs. Most members indicate they could introduce government persuasion and compulsory orders immediately or in a short time and a majority could introduce allocation within a short time to several weeks. Rationing would take most countries longer. Some members did not specify the time needed to introduce allocation or rationing. Information was not

available on how long it would take for the measures to become fully operational.

When the IEA Secretariat asked members what types of demand restraint measures they would likely use to reduce oil consumption by 5 and 10 percent over 6 months and the kinds of oil products to which the demand restraint measures will be applied, nineteen members responded.[6] To achieve a 5 percent reduction, 8 members said they would be prepared to rely only on persuasion and/or compulsory orders. Even so, 11 members said they would apply allocation or rationing, if necessary, to one or more of the following products: gasoline, gas/diesel oil, residual fuel oil, and liquid petroleum gas. To achieve a 10 percent reduction, only three members said they would limit themselves to persuasion and/or compulsory orders. Sixteen members said they would use allocation or rationing on one or more petroleum products. Apart from the United States, eleven of the members also estimated the reduction in oil consumption they would expect to realize from the various measures. Nine members said they would rely on the measures to reduce total final consumption by either 5 percent or 10 percent as required by the emergency situation. One member said it would reduce consumption by somewhat more in both cases and another by somewhat less.

[6]The United States also responded to this inquiry but only provided information on measures to reduce consumption in the federal government.

Table III.1: Number of Members Which Have Various Demand Restraint Measures Available and Time Needed to Introduce Them[a]

When measure can be introduced	Type of Measure			
	Government persuasion	Compulsory orders[b]	Allocation[c]	Rationing[c]
Immediately	13	12	6	2
Few days/short time	2	4	5	
Some or several weeks			3	5
Few or several months				5
Many months or a long time				2
Time not specified	3	2	6	5
Total members having measure	18	18	20	19

[a]The United States is not included in the table.

[b]Compulsory orders include such measures as restrictions on building temperatures, gasoline sales, and gasoline purchases.

[c]Price controls may be used with allocation and rationing. Ten members indicated they may employ price controls but did not report the time that would be needed to introduce them.

Source: Compiled from a 1987 IEA background paper on the IEA emergency response system. During an IEA test conducted in early 1988, members provided updated figures. However, we did not make use of this information, since the updates did not cover all the categories and there was a question about comparability of the data that was provided.

In April 1988, an IEA official told us that results of the 1988 Coordinated Emergency Response Measures Test suggest that members would be less likely to resort to allocation or rationing in smaller disruptions, probably because they have more confidence in their other demand restraint measures.

United States Disputes Estimates

In April 1987, the United States presented figures to the IEA which disputed other members' abilities to reduce demand by 5 to 10 percent during a serious oil supply disruption. The U.S. figures were based on an analysis prepared by Charles River Associates (CRA), under contract to DOE. The analysis was largely based on U.S. data and experience, and did not examine the specific plans and programs of other IEA members.

Table III.2 presents the consumption reductions which DOE/CRA estimated would be most likely for all IEA members other than the United States if a major disruption (about 12 percent of oil supply) occurred in 1990 and lasted for 6 months. A 12 percent oil shortfall would impose an obligation on members to reduce consumption by 10 percent. The table shows that light-handed measures, such as lower speed limits and building temperature restrictions, were expected to have measurable

impacts by the second month. However, the consumption reductions are relatively small, slightly less than 2 percent.

According to the DOE/CRA analysis, heavy-handed measures, such as allocation and rationing, could produce additional monthly consumption reductions of nearly 3 percent, but not until the fifth and sixth months. Their analysis assumed that most IEA members would begin with less interventionist type measures and wait to see whether these alone achieved desired consumption reductions. In combination and over the first 6 months, demand restraint measures that reduce consumption independently of oil price increases are most likely to reduce consumption by only 2.4 percent.

DOE/CRA concluded that the effectiveness of the demand restraint measures is highly uncertain. If IEA members begin by implementing light-handed measures and then wait for a few months to see how well they work, data and decision lags could delay heavy-handed allocation or rationing until after the fourth month, in which case the measures would have only a minimal effect in restraining oil prices and minimizing adverse economic impacts. Moreover, since the reductions in energy consumption due to demand restraint measures and the extent of actual implementation are extremely uncertain, the estimated consumption reductions could be much less—as little as 1.2 percent, or half the levels presented in table III.2. On the optimistic side, consumption reductions might be 3.6 percent, or half again as high as the base case.

Table III.2: DOE/CRA Estimated Oil Consumption Reductions From Demand Restraint Measures for Members Other Than the United States, 1990[a]

Figures in Percent of total oil use

	Month During Disruption						
Measures	**1**	**2**	**3**	**4**	**5**	**6**	**Avg.**
Light-handed							
Lower speed limits	0	0.4	0.4	0.4	0.4	0.4	0.3
Weekend driving ban	0	0.7	1.4	1.4	1.4	1.4	1.1
Lower building temperature	0	0.1	0.1	0.1	0.1	0.1	0.1
	0	**1.2**	**1.9**	**1.9**	**1.9**	**1.9**	**1.5**
Heavy-handed							
Allocation and/or rationing	0	0	0	0	2.8	2.8	0.9
Total	**0**	**1.2**	**1.9**	**1.9**	**4.7**	**4.7**	**2.4**

[a]Figures are for the base or most likely case.

Source: Analysis of IEA Energy Emergency Preparedness, prepared for DOE by Charles River Associates Incorporated (contract No. DE-AC01-85IE10481), Sept. 29, 1986, pp. 16-148.

The DOE/CRA estimate differs significantly from what a number of IEA members have told the IEA Secretariat. As previously discussed, 14 members have said they could introduce an allocation program immediately or within several weeks and seven could introduce a rationing program within that time period. An IEA official told us that the DOE/CRA estimate was unrealistic and that their assumption about when the measures would be introduced in a severe oil supply disruption was particularly unfair.

Dutch/West German Estimates Contradict DOE/CRA

About the time the CRA study was being completed, the Dutch and West German governments commissioned studies of demand restraint consumption reductions their countries could achieve.[7] The two studies estimate maximum consumption reductions that could be achieved without regard to the size of a disruption. The results differ significantly from the DOE/CRA findings.

In contrast to the DOE/CRA estimate of consumption reductions of 1.5 percent for light-handed demand restraint measures, the Dutch study estimated consumption reductions between 6 to 12 percent and the West German study at about 14 percent. The studies project consumption reductions 4 to 9 times greater than DOE/CRA's base case, suggesting that light-handed measures alone might be sufficient to realize an IEA demand restraint obligation of 7 to 10 percent.

Some of the differences are due to measures which DOE/CRA did not consider. For example, the West German study estimated that a government appeal for reduced consumption of gasoline and diesel fuel could reduce total oil consumption by about 3 percent in 1995. There are, however, substantial differences between the DOE/CRA and the Dutch and West German estimated consumption reductions for speed limit restrictions, driving bans, and reduced use of light heating oil in homes and commercial establishments.

Concerning heavy-handed measures, i.e., allocation and rationing, the differences are even more dramatic. DOE/CRA estimated that other IEA members could achieve peak consumption reductions of about 3 percent and that over a 6-month period the reductions would average only about

[7]The West German study has been published. See German Institute for Economic Research, Efficiency of Measures to Restrict Consumption During Petroleum Supply Disruptions, Berlin, Nov. 1986.

1 percent. The estimate was for gasoline only. In contrast, the West German study estimated that motor fuel rationing could realize consumption reductions of about 4 to 6 percent of total oil consumption and rationing of light heating oil about 5 to 6 percent, for combined consumption reductions of about 9 to 12 percent. Similarly, the Dutch study estimated that motor fuel rationing could realize consumption reductions of about 17 percent of total oil use. In addition, it estimated that the chemical industry could achieve consumption reductions of up to 10 percent of oil use. When combined with motor fuel reductions in consumption, total estimated reductions approach 27 percent of oil use.

DOE officials told us they found it difficult to believe that the Netherlands or West Germany could in practice quickly achieve such consumption reductions.

Clearly, there are major differences between the DOE/CRA and the Dutch and West German estimates of demand restraint savings. Although detailed analysis of these studies and their differences was beyond the scope of our review, we make the following observations.

- The Dutch and West German estimates, if realistic, may not be representative of other IEA members' capabilities.
- For the most part, the West German and Dutch estimates do not identify how much reduced consumption could be realized during successive months from the onset of a disruption. To be effective, the measures used must work quickly; otherwise, already increasing oil prices would rise higher in response to excess demand. Further, if the light-handed measures do not quickly produce substantial consumption reductions and if the Dutch or West German governments take several months to judge their effectiveness, the figures exaggerate the countries' capabilities for that time period.
- The Dutch and West German estimates exclude effects of rising oil prices. The studies recognize that rising prices will stimulate reduced consumption. However, they do not estimate to what extent rising prices will stimulate reductions before the demand restraint measures can fully achieve their estimated savings.
- DOE/CRA, by drawing largely on U.S. experience and not including certain measures, may have significantly underestimated demand restraint potential for IEA members other than the United States.

In commenting on our analysis, an IEA official said that the Secretariat encouraged the type of analysis conducted in the three studies as they could act as a catalyst for many other members to undertake similar

analyses. At the same time, he said, the Secretariat was hesitant to directly compare the results of the studies because of differing methodological approaches and national environments or to draw any definite conclusion on the effectiveness of demand restraint in general. The official also told us that the U.S. study was not very well received by some IEA European members, who felt it was overly critical and did not take into account all the facets and possibilities of demand restraint programs. In addition, he said, the U.S. view is based considerably on its past experience with demand restraint measures. However, the United States previously had used price controls which hindered the market from adjusting to rising prices. The official noted that many IEA members have eliminated price controls or made them more flexible to allow for price adjustments.

Estimates of Consumption Reductions Due to Demand Restraint Measures Need to Account for the Effect of Price Increases

Estimates by member countries, as reported by the Secretariat, on how much their demand restraint measures (i.e., persuasion, compulsory orders, allocation, and rationing) could reduce consumption, do not indicate to what extent the reductions might be affected by rising oil prices. It is possible that some or even many of the estimates assume that part of the reductions would result from increasing prices. The authors of the detailed Dutch and West German estimates indicated that their estimates excluded the effects of rising oil prices. In other words, they sought to estimate how much their measures could reduce consumption apart from any increases in oil prices. The authors said that rising oil prices could lead to additional consumption reductions. However, the studies did not estimate whether and, if so, to what extent rapidly rising oil prices, early in a disruption, might preempt some of the expected savings from the demand restraint measures. If a country delays introducing one or more of its measures or if it takes some time for the measures to become fully operational, oil prices may rise considerably in the interim, resulting in reduced consumption.

It is important to distinguish between reduced oil consumption attributable to demand restraint measures that reduce consumption independently of price increases and reductions due to oil price increases for several reasons. First, price increases could lead to significant demand reductions but have serious adverse impacts on economic performance. During the 1973-74 and 1978-79 disruptions, oil prices rose dramatically and were a factor in reducing consumption. Also, the price increases contributed importantly to the economic recessions that followed.

For example, between September 1978 and September 1980, the 1979 Iranian oil supply interruption caused crude oil prices to increase from $13 to $32 per barrel. The Organization for Economic Cooperation and Development estimated that by the end of 1981 the higher oil prices since the start of the disruption had resulted in a total loss in real income to its member countries of nearly $1 trillion.

Second, a principal objective of the IEA is to limit world oil price increases that can occur during a serious disruption and hence the economic losses that accompany such price increases. While IEA considers it permissible to rely on rising oil prices to reduce demand, it would not be fair if some members relied largely on price increases to achieve their demand restraint obligations during a disruption if others drew down substantial amounts of emergency oil stocks.

Drawdown of oil stocks can be expected to exert downward pressure on world oil prices and thus benefit all IEA members, including those that do not draw stocks. In contrast, to the extent that world oil prices rise higher than they otherwise would because some IEA members do not draw stocks and do not curb their demand via non-price demand restraint, all members will suffer from the economic effects of higher prices.

IEP emergency oil stocks are costly to buy and maintain and are a finite resource which can be used only once. They are probably[8] more expensive to establish and maintain than are most, if not all, demand restraint measures. Consequently, members which have gone to the expense of building emergency oil stocks and which plan on using them should know whether other members' non-price demand restraint measures can effectively reduce demand and thus also benefit fellow IEA members.

Making estimates of the effects of both non-price demand restraint measures and rising oil prices could help members better understand the likely effectiveness of their demand restraint measures and the extent to which their measures can contribute to the IEA's objective of restraining world oil price increases during a disruption.

Members which plan to use IEP emergency oil stocks in a substantial way need assurance that the other IEA countries' non-price demand restraint measures will work effectively. Otherwise, member governments may

[8]The IEA has collected data on the cost to acquire and hold emergency oil stocks, but not on the cost to establish and maintain various standby demand restraint measures.

delay use of their emergency oil stocks at the onset of a disruption and/or decide to draw less stocks than they otherwise would. They could experience serious difficulty in explaining to their citizens why they are drawing down valuable stocks while other nations are neither drawing stocks nor implementing effective non-price demand restraint measures.[9]

Neither the IEP Agreement, which established the ESS, nor subsequent agreements among the members which have elaborated on it, have set any requirement concerning what contribution should be made by non-price measures relative to the consumption reductions that would occur due to oil price increases.

Setting a specific requirement may not be feasible because it might be very difficult for the members to agree on a standard that would be perceived as equitable for all and easy to implement. However, reliable estimates of the likely contribution of each member's non-price demand restraint measures relative to rising oil prices should be encouraged. And, members should be willing to share with other members detailed information on how the studies were made and the results.

The IEA needs to study devising a method for estimating, during or following an oil supply disruption, the extent to which each member's reduced consumption was due to non-price demand restraint and to rising oil prices. This is important because forecast savings may not reliably predict actual savings. Assessing how effectively measures worked during a specific disruption may reveal a need for some members to improve particular measures, drop them, or supplement their use with other measures while the emergency continues. Such analyses may also enable the IEA to significantly improve preparedness for subsequent disruptions.

The Secretariat has said that during disruptions it would evaluate members' reports about response measures taken and the expected volumetric effects of those measures against available data on actual oil supply, consumption, and stocks. However, a problem arises if this approach is used to judge the effectiveness of demand restraint measures. For example, when a member says it has employed voluntary persuasion and

[9]We are not suggesting that the United States should not draw down the SPR during a serious disruption if some IEA members do not have effective demand restraint programs and do not draw down their IEP emergency oil stocks. Some analysts have concluded that the United States would be better off to unilaterally draw down SPR oil than not act at all.

compulsory orders measures and it expects they will reduce consumption by 10 percent, it does not necessarily follow that if oil demand falls by 10 percent, the measures were responsible for all or most of the reduction. People may have reduced consumption largely in response to rising prices.

In principle, during and immediately following an oil supply disruption, econometric techniques could be used, with pre-disruption and disruption data, to estimate what proportion of each member's demand reduction during the disruption was due to price increases and what part to non-price demand restraint measures. However, the IEA has not studied the merits of such a method.

Secretariat Proposal That Members Provide Price Information Not Approved

In 1986, the Secretariat proposed that all members begin providing periodic estimates during non-disruption periods on how much oil consumption could be reduced as a result of non-price demand restraint measures and how much as a result of price effects. Members were to provide information on maximum achievable capabilities within one and two months after introduction—given existing laws, programs, and other capabilities. However, several members opposed the proposal on the basis of the reporting burden, the difficulty of estimating emergency response capabilities in advance of a supply disruption without specific information on its characteristics, and the possibility that the information would be of little value in the event of an oil supply disruption with different characteristics.

Members which have objected to providing estimates may take that position because their programs are not sufficiently developed or because they do not want to go to the expense of preparing such estimates. Another possibility is that so many factors and variables are involved that reliable estimates cannot be made or that it would be difficult or costly to do so.

Undoubtedly, burdens are involved in preparing reliable estimates of the results of various demand restraint, fuel switching, and other emergency preparedness measures. But, those members which do not plan on using IEP emergency oil stocks to help fulfill demand restraint obligations should recognize that there is a continuing and substantial burden on those members which are maintaining large IEP emergency oil stocks. If members are not able to estimate reliably what consumption reductions their programs can achieve apart from rising oil prices and what

would be the effect of rising prices, they could be encouraged to request the IEA to assist them in developing appropriate methods.

In commenting on our analysis, the IEA Secretariat said that separating the effects of price and non-price demand restraint measures might be useful to have but would be difficult to establish in practice. Assessing price effects on demand, even with "ex post facto analyses," it said, would present a number of serious technical and political difficulties, including the determination of price levels to be assumed for purpose of analysis.

Concerning the costs of IEP emergency oil stocks relative to the effectiveness of demand restraint measures, the Secretariat said that the two should no longer be viewed as mutually exclusive alternatives, since a growing number of IEA members are showing preparedness to use both, depending on the specific oil supply disruption.

The Cost Effectiveness of Non-Price Demand Restraint Measures Is Not Clear

When assessing the cost/benefit of demand restraint measures relative to policy alternatives such as drawing down IEP emergency oil stocks, several types of costs need to be considered. First are the administrative costs to establish and maintain non-price measures on a standby basis and to implement such programs if an oil supply disruption occurs. Administrative costs include expenses of monitoring and, if called for, enforcing programs.

Another type of cost concerns the impact of non-price measures on economic performance. From the perspective of maximizing economic output, allowing rising oil prices to allocate reduced supplies may be more efficient than resorting to non-price demand restraint measures which force reductions in supplies apart from the economic value which users attach to them. But, if an economic system has rigidity that prevents a quick reallocation of productive factors (labor and capital) from high oil-using sectors to lower oil-using sectors, the efficiency gains potentially realizable under market mechanisms might be more than offset by the adjustment costs associated with the underutilized human or capital resources.

A third type of cost concerns the increased income transfer to oil exporting nations resulting from higher oil prices. Where petroleum imports account for a significant share of total domestic oil consumption, sudden petroleum price increases draw income from the national economy and retard economic growth. If non-price demand restraint measures keep

prices from reaching higher levels, the transfer income loss will be smaller. And, the potential efficiency losses associated with the measures' use may be more than offset by the reduction in macroeconomic losses they achieve due to smaller oil price increases. According to one study on the subject,[10] demand restraint measures have not been explored in enough detail to know whether the net macroeconomic benefits exceed the sum of their costs. An important reason why, according to the author, is that current macroeconomic models are not conceptually or empirically adequate to analyze the problem.

In comparing demand restraint measures to policy alternatives, such as building IEP emergency oil stocks for drawdown during a disruption, it is necessary to consider the probability of disruptions and their expected size and duration. Whether stocks would be cheaper than demand restraint will depend in part on the frequency, size, and duration of disruptions. If substantial stockpiles are created and disruptions seldom occur, oil stockpiles may not be as cost effective as demand restraint measures. The comparison between the two alternatives also depends on when oil supply disruptions are expected to occur. If stocks are maintained for a long period of time before a disruption occurs, the stocks approach may have higher present value costs compared with demand restraint.

The United States believes that the economic cost of building and holding emergency oil stocks is less than the cost of using demand restraint measures and doing with less oil during disruptions.

In July 1984, the IEA Governing Board decided to further examine the potential economic impacts of serious oil supply disruptions on each member and the cost and benefits of demand restraint measures. However, not much progress was made and the IEA is no longer working on these issues.

In early 1985, the Secretariat did ask all members to identify the percentage of gross domestic product (GDP) that would be lost as a result of specific demand restraint measures that each might use to reduce oil consumption by 5 and 10 percent. It did not ask them to compare the results to the cost of holding stocks. Only eight members provided a

[10]Scott A. Noll, An Economic Analysis of Energy Demand Restraint Measures, unpublished Discussion Paper D-82T (Washington, D.C.: Resources for the Future, Jan. 5, 1984). See also B.G. Hickman, H.G. Huntington, and J.L. Sweeney (eds.), Macroeconomic Impacts of Energy Shocks: A Summary of the Key Results (North-Holland, 1987). The study discusses the inability of macro models to analyze the effects of price controls and distributional impacts by industry or region.

broad estimate of the GDP loss expected to result from use of demand restraint measures. The eight members did not separate the effect of non-price induced demand restraint from the effect of rising prices. They used different methodologies and qualified their results on the basis of limited methodology available to measure non-price effects and different expectations of consumer and industry behavior. Only two members used an input/output model in their assessments. Estimates of the possible GDP loss from implementation of 5-percent demand restraint for the eight members ranged from 0.2 to 1.4 percent. Estimates for 10-percent demand restraint ranged from 0.5 to 4.5 percent.

Because the members did not separately estimate the costs of allowing rising oil prices to achieve the 5 and 10 percent demand restraint, the results do not provide information on the comparative advantages of relying on oil price increases versus non-price measures. From information provided by the Secretariat, it is not clear whether the members included administrative costs of maintaining demand restraint measures on a standby basis and costs of implementing them during the hypothetical disruptions.

IEA members and the IEA Secretariat have not estimated the relative costs and benefits of stocks and demand restraint measures. To do so would require making important assumptions about several key variables whose values cannot be known with confidence, including the magnitude, length, and probability of future oil supply disruptions and the price path of oil during such disruptions.

U.S. Estimate of Demand Restraint Economic Cost Relative to Stockdraw

DOE and CRA estimated the economic cost of non-price demand restraint measures relative to using emergency oil stocks.[11] The starting point for the analysis was a hypothetical world oil supply disruption of 6 MMBD occurring during a six month period in 1990.

DOE/CRA estimated that, compared with simply relying on the free market to equilibrate supply and demand in the disruption,[12] early large coordinated stockdraw by the United States and other IEA members (2.3

[11]"Economic Costs of Demand Restraint," U.S. government paper presented at IEA Workshop on Practical Aspects of Oil Consumption Reduction Measures by Inja K. Paik, DOE, Apr. 14, 1987. Analysis of IEA Energy Emergency Preparedness, prepared for DOE by CRA (Contract No. DE-AC01-85IE10481), Sept. 29, 1986. Wharton Econometric Forecasting Associates provided technical assistance.

[12]Real GDP for 1990 for all IEA members was estimated at $8,963 billion (1980 dollars) without a disruption and at $8,747 billion if the market were relied on to equilibrate supply and demand.

MMBD and 2.0 MMBD, respectively) would reduce GDP losses by $111 billion in the IEA countries. DOE/CRA further estimated that, compared with relying on the market, early large stockdraw by the United States (2.3 MMBD) and demand restraint by the other IEA members (2.0 MMBD) would increase GDP losses by an additional $208 billion. Thus, DOE/CRA's figures show the coordinated stockdraw approach reducing net GDP losses by about $319 billion compared with the mixed approach of the United States drawing oil stocks and other IEA members using their demand restraint measures. According to their analysis, the increase in GDP losses is entirely attributable to the demand restraint. An IEA official told us that the U.S. study was not well received by some European members, who felt it was overly critical and did not take into account all the facets and possibilities of demand restraint programs.

DOE/CRA used Wharton Econometrics' world economic model to estimate GDP losses associated with the free market and early large, coordinated stock drawdown option. Concerning demand restraint, they assumed consumers, voluntarily or in response to government-imposed light-handed measures, could reduce oil consumption by 1 MMBD with no adverse impact on economic performance. The reductions would come mainly out of discretionary oil consumption, such as gasoline use.

They estimated that the second 1 MMBD of demand restraint would come from direct cutbacks in production. Rationing and allocation measures would be needed. They estimated that GDP losses were approximately equivalent to the proportional cutback in oil use resulting from the second 1 MMBD of demand restraint. This estimate was made by using the inverse of an assumed income elasticity of demand for oil of 0.9. Since the second 1 MMBD of demand restraint accounted for 6.5 percent of oil consumption, they estimated that it would cause about a 7.2 percent reduction in GDP for IEA countries other than the United States.

DOE subsequently prepared a revised lower estimate, using U.S. input/output data (assuming price-sensitive input coefficients), to calculate the extent to which oil savings could be achieved in the industrial, commercial, and transport (excluding pleasure driving) sectors through inter-fuel substitution and more efficient oil use. The results were extended by analogy to other IEA countries. DOE assumed the three sectors would initially have to absorb an oil shortfall equal to 6.5 percent of U.S. oil consumption. DOE then estimated that the total savings which could be realized from inter-fuel substitution and more efficient oil use by the sectors at only 0.5 percent. DOE concluded that the remaining 6

percent of the shortfall would result in a corresponding 6 percent decline in GDP. The analysis did not allow for fuel switching or more efficient fuel use by the electricity sector. And, it assumed no change in inter-industry production levels.

The DOE/CRA analysis was not designed as a comprehensive cost/benefit study. The focus was primarily on the performance of each policy measure during one hypothetical oil supply disruption. It did not consider the costs of preparing and maintaining standby programs for emergency implementation, including pre-disruption expenditures to build up emergency oil stocks and to prepare demand restraint measures. And, it did not account for the likelihood of future disruptions. Consequently, we do not believe the analysis is adequate to support a conclusion that emergency oil stocks are superior to demand restraint measures on a cost effectiveness basis.[13] However, we do believe it could provide a basis for further examination of the issue by the IEA.

The results of the DOE/CRA analysis were provided in a paper presented to an IEA workshop in 1987. However, an IEA official advised us that while the Secretariat has been trying to secure as much information as possible on the relative costs and benefits of stocks and demand restraint, available information was insufficient for providing reasonable comparative figures. He said that members are not willing at this time to spend the time and resources required to estimate the relative costs and benefits of the two approaches. He noted that in 1987 the United States had offered to conduct a seminar for other members showing how it models optimum size and drawdown rates for the SPR but that other members were not interested then because they were busy preparing for a new round of IEA reviews of their emergency response programs and for the Coordinated Emergency Response Measures Test in early 1988. More recently, they were preparing for a fall 1988 test of the ESS. He said the IEA may return to the subject in the future. Another IEA official said he did not think much could be accomplished on the issue.

Given the difficulties and uncertainties involved in making cost effectiveness estimates, it is understandable why some IEA members have been reluctant to commit the IEA Secretariat or individual members to

[13]CRA's analyses briefly compared costs between holding oil and employing speed limit reductions and a one day per week driving ban and concluded that the cumulative costs of stockpile maintenance over 10 to 15 years were comparable to the costs per barrel of implementing driving bans or lower speed limits. Given its other analysis which showed stockdraw yielding larger benefits than demand restraint during a disruption, CRA concluded that oil stocks are clearly the preferred measure.

making such estimates. It is also possible that some countries prefer not to make estimates because the results may not be favorable. The DOE estimate indicates that use of emergency oil stocks would dramatically reduce gross domestic product losses compared with substantial reliance on demand restraint. In view of this result, it would benefit the IEA to convene a group of experts to consider more systematically the problems that would have to be overcome in making realistic estimates of the relative macroeconomic costs and effects of stocks and demand restraint, the limitations that would be inherent in the results, and the cost of making such estimates. As part of the effort, the group could assess the method that was used by DOE. The overall purpose would be to gather information and expert views on whether and, if so, how the IEA Secretariat or individual members could make meaningful estimates in this area.

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