

**FIGHTING THE LAST WAR: PREPARATIONS FOR THE  
NEXT OIL CRISIS**

**Michael C. Lynch  
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## FIGHTING THE LAST WAR: PREPARATIONS FOR THE NEXT OIL CRISIS

**"Those who cannot remember the past are condemned to repeat it."  
--George Santayana, 1906**

**"History is more or less bunk." -- Henry Ford, 1916**

### Introduction

Although the term "Energy Crisis" became current only in the 1970s, the notion of protecting one's energy security has a long and noble tradition. Yet in fact, concerns about the security of national oil supplies have long preoccupied policy-makers, and the policies being crafted today have seen similar expressions in the past, and the use of oil as a political weapon hardly originated with the Arab Oil Embargo of 1967.<sup>1</sup>

While it might be argued that governments have been successful in their search for energy security in that few factories have shut down or homeowners frozen to death or military units paralyzed, in fact enormous economic damage has been done by a combination of the price increases that occurred in the 1970s, and the wastefulness of the policies imposed in response to them. This reflects, in part, the competing demands on those policies, but also the failure of policymakers to understand the nature of mineral resources, as well as the poor guidance they have received from analysts. All too frequently, the focus of energy policy on has been on the reasons for the most recent oil crisis, rather than the probable causes of the next.

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<sup>1</sup> In fact, the threat to withhold Middle Eastern oil supplies as a part of the Arab-Israeli conflict dates to 1947. See Oil and Gas Journal (OGJ) 12/27/47.

### The Current Vulnerability

"Working abroad in Iran, you can achieve exceptional financial gains, as well as give yourself and your family the exciting experience of living in the fascinating 2500-year-old empire long called Persia. The official language is Farsi, with English widely used. Long politically stable, Iran has been moving forward a huge, complex program of land reform, education, and modernization." --advertisement in February 1978, Journal of Petroleum Technology [emphasis mine]

Generally, another oil crisis is said to be unlikely today.<sup>2</sup> For one thing, supply is more diversified, and thus less vulnerable. In addition, there is a large amount of surplus producing capacity available to replace any that is disrupted. Also, consumers use far less oil than before, and governments have built up large stockpiles to be released to replace disrupted supplies.

Yet, all of this is illusory. The diversification of supply reduces the expected size of any disruption, yet the impact of the size of the disruption is relative, not absolute. If available replacement capacity is smaller, than a smaller disruption will have the same effect on the market as if both are larger, ceteris paribus.

In 1978, the amount of surplus capacity was said to be 6.2 million barrels per day (mb/d), and the disruption in 1979 involved a loss of about 6 mb/d for several months, including perhaps .5 mb/d of the surplus capacity.<sup>3</sup> Yet, this resulted in a two year oil crisis.

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<sup>2</sup> For example, see "There's Oil Enough in Theory Even if Upper [Persian] Gulf Closes," Petroleum Intelligence Weekly (hereafter PIW) 6/4/84, p. 5.

<sup>3</sup> 1978 production was 30.275 mb/d, according to BP Statistical Review of the World Oil Industry, while the CIA, in International Energy Statistical Review, (hereafter IESR) 11/29/78, put "maximum sustainable" capacity at 36.48 mb/d. The capacity figure is only an estimate, one which has gotten less reliable over time.

The present situation is not much improved, despite the pervasiveness of the belief in abundant surplus capacity. Recent reestimates of capacity in OPEC nations suggests that at any given time, the amount of capacity outside of Saudi Arabia is only 18 mb/d, leaving current surplus capacity at 4 mb/d.<sup>4</sup> Since the worldwide inventory build from the end of the first quarter of 1979 to the end of the third quarter in 1980 was put at 2.4 mb/d, with a quarterly peak of 4.7 mb/d in the third quarter of 1979,<sup>5</sup> current levels of surplus capacity can be seen to be insufficient to prevent another series of price increases in the case of a loss of Saudi supplies due to war, sabotage, or insurrection. Increased demand for OPEC oil is unlikely to bring an increase in production capacity in the short-term, so that the level of surplus capacity available should decrease for several years to come, especially if low oil prices increase demand.

Reliance on capacity which is not being produced is also risky, and not just from the possibility of a lack of political will to produce. In 1967, production capacity in Texas was reported to be 5251 tb/d, about twice the level of production in May of that year.<sup>6</sup> When the Arab Oil

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<sup>4</sup> See "Oil Safety Margin Shrinking as Spare Output Capacity Dips," PIW 8/20/84. IESR, 1/20/86, puts OPEC capacity at 34.4 mb/d, but that includes Iran at 5/5 mb/d and Iraq at 3.5 mb/d, roughly the pre-war levels. (They do indicate that the loss in capacity in Iran is "uncertain" and the Iraqi figure is admitted to be pre-war.)

<sup>5</sup> Worldwide stocks were estimated by the Department of Energy and published in International Energy Indicators, Feb.-Mar. 1982, p. 8. (The publication has since been replaced by International Petroleum Statistics Report.)

<sup>6</sup> Capacity from Sam H. Schurr and Paul T. Homan, Middle Eastern Oil and the Western World: Prospects and Problems, Elsevier 1971, p. 40; production from Bureau of Mines, Mineral Industry Surveys: Crude Petroleum, Petroleum Products, and Natural Gas Liquids 1967, (hereafter

Embargo resulted in a loss of 5000 tb/d, the Texas Railroad Commission authorized an increase in allowable production from 3.2 mb/d to 4.2 mb/d on July 15, but production peaked at 3.6 mb/d for the month of August.<sup>7</sup> Based on this experience, it was subsequently estimated that the 4 mb/d of surplus capacity was really only about 1 mb/d, and 90 days would be required to reach that level, with one year needed to bring the full 3.5 mb/d on-line.<sup>8</sup> More recently, Texas gas producers found themselves only able to deliver at 60 percent of their stated capacity during the December 1983 cold wave, although short-term technical problems were said to be the source of most of the problems.<sup>9</sup>

Certainly, the availability of strategic stocks in the United States, Japan and West Germany will help to ameliorate any loss of supply, but only if used. Past experience, discussed below, suggests that governments will be unwilling to release these stocks in time of need, fearing that the need for them might increase. And the failure to make supplies available would hardly be new. Consumer governments, fearing a worsening of the crisis in 1979, sought higher stocks, as discussed below. And in early 1979, the Saudis reduced production, arguing that the resumption of Iranian production made their supplies unnecessary, and only threatened to raise inventories, such as occurred in late 1977 and resulted in

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MIS) p. 8.

<sup>7</sup> Production from MIS 1967, p. 8, and the decision cited in Office of Oil and Gas, U.S. Department of the Interior, Middle East Petroleum Emergency of 1967, (hereafter MEPE) vol. 1, p. 30.

<sup>8</sup> Schurr and Homan, op. cit. NPC 1981, Chapter 4, p. 5, put the lag time at four to six months, the amount available having declined to 326 tb/d.

<sup>9</sup> World Oil, 4/84, p. 11.

substantial subsequent market weakness. In fact, the same argument was used by the Texas Railroad Commission in 1956, when it was reluctant to allow production to increase because it wanted to reduce what it felt were surplus inventories.<sup>10</sup>

Beyond that, the size of the stocks might prove inadequate. The end of the Iranian Oil Crisis was signalled when storage capacity was full: companies were physically incapable of accepting any further surplus supplies and had to reduce purchases.<sup>11</sup> The total world stock build in that crisis was 1.3 billion barrels, about twice the present available level of government stocks.<sup>12</sup> (In the United States, the onshore build was 250 million barrels, half the current level of the Strategic Petroleum Reserve.) If filling the companies' storage capacity is what is needed to reduce panic purchases of oil, then government stocks are not, by themselves, adequate.

This is all the more true considering the amount of empty storage capacity still available. In the United States, primary storage capacity

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<sup>10</sup> Petroleum Press Service, 1/57, p. 2.

<sup>11</sup> See "Spot Crude Prices Worn Down Further by Swelling Stocks," PIW 7/14/80, p. 1, which reported "Every nook and cranny in the world oil supply system is rapidly filling up with surplus crude oil." Companies were forced to rent tankers for floating storage due to a lack of available onshore tankage. Private stocks had reached 90 percent of primary storage capacity at that point. See below.

<sup>12</sup> Strategic inventories directly under the control of governments include 500 million barrels in the United States, about 120 million barrels in Japan, and 130 million barrels in W. Germany. For U.S. and Japan, see IESR, 1/28/86, p. 15. W. German government controlled inventories are required to be no more than 5 percent above 65 days of consumption, with 1984 consumption at 2 mb/d. See PIW 11/22/82, p. 7, and IESR 1/28/86, p. 12.

has declined less than the decline in the amount of primary inventories.<sup>13</sup>

The amount of empty primary storage capacity in the United States in March 1986 is roughly 425 million barrels.<sup>14</sup> And while secondary and tertiary inventories are not measured, meaning an exact estimate of unused storage capacity below the primary level is impossible, it would appear to be greater than 500 million barrels.<sup>15</sup>

On a world level, no estimates of foreign storage capacity are readily available, but the amount of storage capacity available in tankers is greater than 700 million barrels,<sup>16</sup> compared to 650 million barrels in

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<sup>13</sup> From March 31, 1978 to March 31, 1983, storage capacity fell by 22 million barrels, while primary inventories fell by about 100 million barrels. (IESR and Monthly Energy Review for inventories, National Petroleum Council, Petroleum Inventories and Storage Capacity, June 1984, p. 6 for capacity.) Primary inventories (and capacity) refers to the storage by oil companies, including refineries, pipelines, and import terminals, which is measured by the government, among others. Inventories (and capacity) held by wholesalers and retailers is secondary, while tertiary refers to consumer inventories (and capacity).

<sup>14</sup> Assuming the March 1983 capacity level of 1500 million barrels has been reduced by 75 million barrels due to closures of refinery capacity and that the storage capacity was so lost. (It may still be available, though not immediately. NPC 1984, p. 6, estimated that 60 million barrels of storage capacity could be reactivated within 90 days. Storage capacity per refinery was calculated from Petroleum Supply Annual 1984, DOE, pp. 81-82, and refinery capacity for January 1, 1983, is from Annual Energy Review 1984, DOE, p. 105, and for January 1, 1986, from Oil and Gas Journal, 1/27/86, p. 74.

<sup>15</sup> In NPC 1984, secondary and tertiary inventory capacity was estimated at 795 million barrels, and inventories at 317 million barrels. Anecdotal evidence suggests that consumers, particularly, have reduced their inventories since then due to expectations of lower prices and the high carrying costs due to high interest rates. See, for example, Boeing's switch from maintaining up to 30 days of inventories to reliance on the spot market, "Oil-Price Drop Spurs Many Firms to Switch from Using Gas, Coal," Wall Street Journal, 4/7/86, p. 1.

<sup>16</sup> The OPEC Annual Report 1984, p. 46, put 1984 surplus tanker capacity at 143 million deadweight tonnes (mdwt), and The Platou Report 3/86, p. 28, lists tanker scrapping at 21 mdwt in 1984 and 31 mdwt in 1985. Assuming that the 1984 surplus is from mid-year and scrapping



1980, despite the scrapping of tankers capable of holding approximately 850 million barrels.<sup>17</sup> Of course, given an increase in Persian Gulf exports, tanker use will increase disproportionately due to the longer distances involved, reducing the amount of storage available in the future.<sup>18</sup>

Onshore storage capacity is obviously quite large, though there are no measurements of it, since from mid-1980 until the end of the third quarter of 1983, inland inventories outside the U.S. had fallen by 700 million barrels.<sup>19</sup> Offsetting this, storage capacity fell by as much as 300 million barrels.<sup>20</sup> While none of these storage estimates is very

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continued at the same pace all year, then by the end of 1985, the surplus would be just over 100 mdwt, which translates into a storage capacity of over 700 million barrels of oil. The decline in 1985 OPEC exports was about 1.5 mb/d, which translates into 30-60 mdwt of tanker capacity, depending on the destinations. The Platou Report only shows about 50 mdwt of tanker capacity on lay-up, but OPEC is including tankers used for storage and capacity which is used inefficiently, eg., slow-steamed. Considering the uncertainty surrounding these numbers, the measurement should not be taken as definitive.

<sup>17</sup> Scrapping from Platou op. cit., and 1980 surplus from OPEC Annual Report 1981, p. 89, and The Platou Report 1980, p. 8.

<sup>18</sup> For example, the distance from Venezuela to New York is 1850 miles, or 5 days of steaming time, while the distance from Saudi Arabia to the U.S. is 8400 miles, or 23 days of steaming time, assuming normal speeds of 15 knots. See OECD, Pipelines and Tankers, Paris, 1961, p. 47.

<sup>19</sup> From International Energy Indicators and International Petroleum Statistics Report, Department of Energy. It is estimated by the author that stocks in transit fell by 200 million barrels during this period.

<sup>20</sup> Taking storage capacity per refinery in Europe and Japan at the same level as in the United States, and assuming the reduction in refinery capacity was matched by closing of the storage tanks. See Lynch, "Export Refineries and Energy Security in Importing Nations," MIT Energy Laboratory Working Paper MITEL 85-020WP, December 1985, Tables 1, 3, for refinery capacity loss. It is possible that some tankage is still in use, as in the United States where 6% of working storage capacity is located at closed refineries (representing approximately 25% of the amount of storage closed over the last 5 years.) See PSA, op. cit.

accurate, the amount of empty capacity obviously overwhelms the government-held inventories.

On the demand side, the world is now much less capable of coping with an oil supply disruption. Because more oil is used in transportation and less in areas like electricity generation, the ease of switching to another fuel has dropped substantially, as has the price elasticity of demand.<sup>21</sup> In 1980, the National Petroleum Council estimated that the second largest source of short-term oil savings in the United States would be fuel switching from oil by electric utilities, to the extent of 400 thousand barrels per day (tb/d),<sup>22</sup> but since that time, oil use in the electric utility sector has dropped by two-thirds.<sup>23</sup>

Examining the changes in demand in the last crisis underlines the importance of this. As can be seen in Figure 1, most of the reduction in U.S. consumption in the first year of the Iranian Oil Crisis occurred in the electric utility sector, even though, in relative terms, it accounted for only 12% of U.S. petroleum consumption in the first quarter of 1979.<sup>24</sup>

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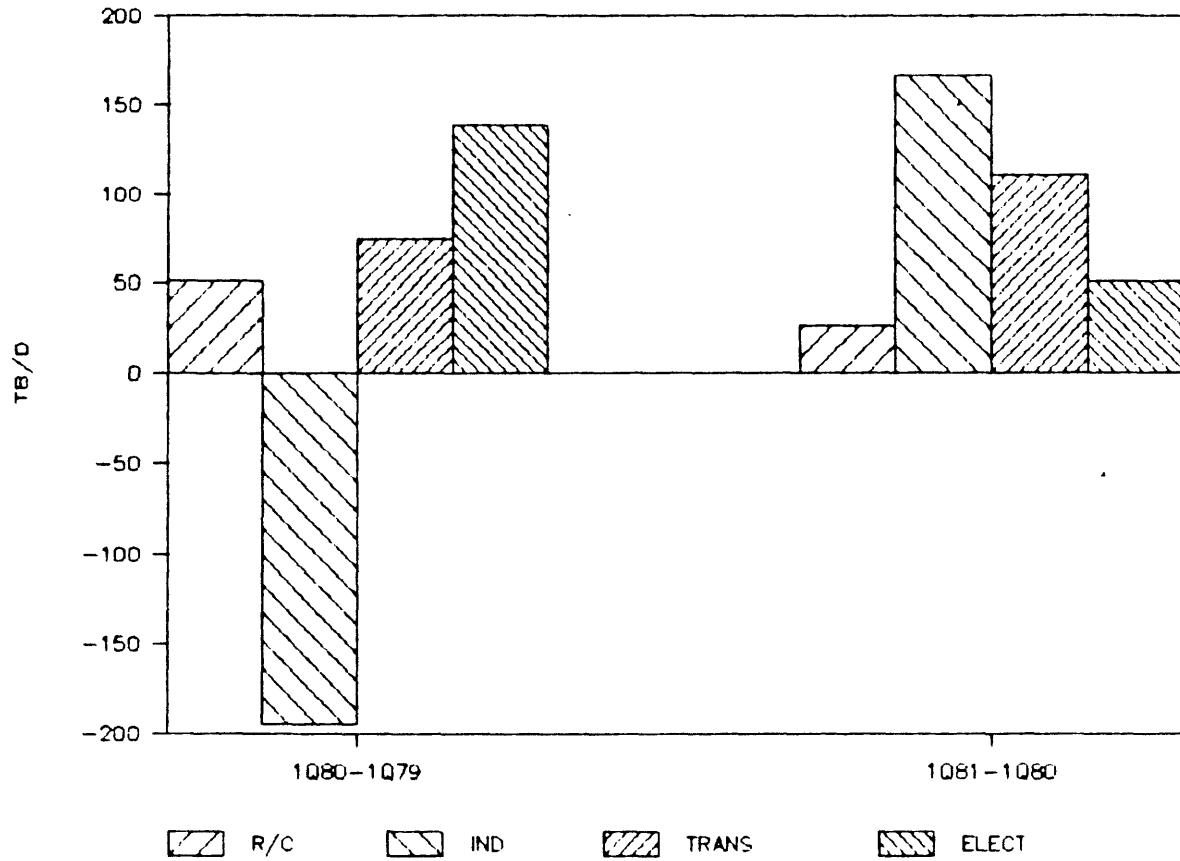
<sup>21</sup> In the OECD, transportation consumption comprised 38 percent in 1973, but had grown to 49 percent by 1983. Organization for Economic Cooperation and Development, Energy Balances of OECD Countries, Paris, various years.

<sup>22</sup> National Petroleum Council's Committee on Emergency Preparedness, Emergency Preparedness for Interruption of Petroleum Imports into the United States, February 18, 1981, Chapter 2, page 5.

<sup>23</sup> See Department of Energy, Monthly Energy Review. See also, Lynch, "Structural Changes in World Oil Markets and Their Impact on Market Behavior," MIT Energy Laboratory Working Paper MITEL 86-009WP, March 1986, pp. 5-7.

<sup>24</sup> Data is from Monthly Energy Review. Residential/ commercial data is 1980 data adjusted to reflect subsequent revision.

FIGURE 1  
OIL DEMAND REDUCTION BY SECTOR  
IRANIAN OIL CRISIS



Source: Monthly Energy Review, Dept. of Energy.

Note: Residential/commercial data adjusted for subsequent revision.

The result of the increased share of consumption in low price elasticity uses is that a higher price increase would be necessary now than in 1979 to reduce demand to accommodate a given reduction in supply. (Low oil prices may reverse this trend.)

A scenario for another oil crisis is easy to construct. Table 1 shows an estimated supply/demand balance for the winter of 1986-87, and the impact that a disruption in Saudi Arabia would have. Since winter demand on OPEC is likely to be as great as non-Saudi OPEC capacity, the potential for another crisis is obvious. Low oil prices will only exacerbate the situation. And since any politically-inspired disruption of Saudi supplies would imply a threat to other supplies on the peninsula as well, including the Iraqi pipeline, consumers are likely to fear a worsening of supplies and build inventories. The supply disruption could be easily be worse than during the Iranian Oil Crisis, although the impact on prices will be dependent on demand and government responses.

Table 1  
Scenario for an Oil Crisis  
Winter 1986-87

	(mb/d)
1. 1986 Demand for OPEC oil	17
a. Seasonal addition	2
--with \$10-\$12 oil	
b. incremental demand due to fuel-switching	1
c. OECD production drop	1
Potential demand on OPEC	21
Potential short-term inventory build in crisis (see text)	3
Potential total short-term demand in crisis	<u>24</u>
2. OPEC Capacity	27.5
of which: Saudi Arabia	8.5
Iraqi pipeline	.5-1.6*
Kuwait + N.Z.	2.6
U.A.E.	2.1
Qatar	.6
Non-Saudi OPEC Capacity	<u>19.0</u>
Capacity perceived at risk if Saudi Arabia disrupted	<u>5.8-6.9</u>
Unthreatened OPEC Capacity	12.1-13.2

\* Capacity end-1985 was .5 mb/d; 1.6 mb/d planned for 1987

### General Energy Policies

"[What was wanted was] an independent source of supply which is, as far as possible, uncontrolled by any agency which can exact undue prices....When we surveyed the whole of the oil-fields, it appeared...that practically the whole area was covered by certain large concessions....It was not only a question of the magnitude of those concerns, it was also a question of whether they were under British control or foreign or cosmopolitan control." -- E.G. Pretyman, 1914<sup>25</sup>

"The United States must now be convinced that control over oil imports and support for indigenous energy resources is vital to its security and credibility as a world power." -- Walter J. Levy, 1970<sup>26</sup>

"[A]s part of our national security interest we need a strong domestic oil industry." -- remark attributed to George Bush in Saudi Arabia, 1986<sup>27</sup>

When it comes to energy policy, Santayana appears to have been correct: there is nothing but repetition. Of course, concerns about security of oil supply are very old, with perhaps the earliest focussed concern about the control of one's oil supplies by foreigners coming from the British Admiralty, cited above, which did not want to build a fleet that would be dependent for its fuel on two foreign companies, Royal Dutch Shell and Standard Oil. But other countries have gone to great lengths to secure reliable oil supplies.

Jimmy Carter's creation of the Rapid Deployment Force for protection of our allies in the Persian Gulf (and their oil fields) was hardly novel: the British dispatched troops from India in 1907 to protect the

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<sup>25</sup> See Parliamentary Debates, House of Commons, Vol. 63, 6/17/14, cited in George W. Stocking, Middle East Oil: A Study in Political and Economic Controversy, Vanderbilt University Press, 1970, p. 13.

<sup>26</sup> "Oil Power," Foreign Affairs, July 1971, p. 663.

<sup>27</sup> See "Saudis are Told U.S. Could Shift Its Policy on Oil," Wall Street Journal, 4/7/86, p. 3.

Anglo-Persian Oil Company's operations.<sup>28</sup> Similarly, the French sought to protect their domestic shale oil industry in the 1920s from competition with cheap foreign petroleum. In the 1950s, the United States began a series of steps that resulted in mandatory oil import quotas to protect domestic oil production, ostensibly to reduce reliance on unreliable foreign sources.<sup>29</sup>

Many of these policies used security concerns, in part, as a rationale for protectionism. Certainly, this is true of attempts to protect the domestic coal industry in much of Europe, the interwar shale oil industry in France, the U.S. domestic oil industry, and the natural gas industry in Canada.<sup>30</sup> As a result, it is difficult to find "pure" examples of policies designed to protect a country from oil supply disruptions, and even many that have been enacted since 1973 still take on the form of protectionism and subsidies.<sup>31</sup>

The disruption of oil supplies has a long and honorable tradition as well. The nationalization of Pemex in 1938 resulted in a loss of supplies to the world of 25 thousand barrels per day (tb/d), 0.4 percent of world

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<sup>28</sup> Stocking, op. cit., p. 14.

<sup>29</sup> See the Cabinet Task Force on Oil Import Control, The Oil Import Question: A Report on the Relationship of Oil Imports to the National Security, U.S. Government Printing Office, February 1970.

<sup>30</sup> The construction of the TransCanada Pipeline was justified, in part, on grounds of national security; the economics did not support it. See Leonard Waverman, Natural Gas and National Policy, 1970.

<sup>31</sup> Legislation has been proposed in the United States that would require the maintenance of a "strategic ethanol reserve" equal to 10% of the SPR, with the obvious intent of bolstering grain prices. See OGJ Newsletter, 10/21/85.

production.<sup>32</sup> Similarly, Mossadegh's 1952 nationalization of the Anglo-Iranian Oil Company's (BP) concession saw a production drop, this time of over 300 tb/d, or about 2.6% of world production.<sup>33</sup> In fact, the loss of 500 tb/d of refinery capacity caused more problems than the loss of crude capacity, something that should be borne in mind by those who insist that export refineries in OPEC countries do not pose a security problem.<sup>34</sup>

Oil embargoes also have a long history. Mussolini considered the threat by the League of Nations to enact an oil embargo against him over his invasion of Ethiopia to be serious enough that he threatened war over the issue,<sup>35</sup> and the oil embargo which the United States enacted against Japan in 1941 was a major force in their decision to attack Pearl Harbor.

Despite all of these occurrences, as well as the post-war disruptions discussed below, energy policy still focuses not on the short-term disruption of supplies, but on long-term scarcity, which is illusory.<sup>36</sup> In 1985, when the IEA published its list of energy policy issues, it included the following:

- 1) energy efficiency;
- 2) diversification of energy supplies;

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<sup>32</sup> Degolyer and MacNaughton, Twentieth Century Petroleum Statistics, annual.

<sup>33</sup> Ibid. Petroleum Press Service 10/56, p. 358, put the loss of capacity at a much higher level, 32 million tonnes, or about 640 tb/d.

<sup>34</sup> Ibid., and see Lynch, "Export Refineries and Energy Security in Importing Nations," MIT Energy Laboratory Working Paper 85-020WP, 12/85.

<sup>35</sup> See George W. Baer, The Coming of the Italian- Ethiopian War, Harvard University Press, 1967, p. 115.

<sup>36</sup> For a good summary, see M.A. Adelman, "Scarcity and World Oil Prices," Review of Economics and Statistics, forthcoming.



- 3) energy pricing and taxation;
- 4) barriers to energy trade;
- 5) environmental issues
- 6) nuclear energy
- 7) emissions from the burning of fossil fuels in stationary sources;
- 8) emissions from motor vehicles; and
- 9) policy on energy and the environment.<sup>37</sup>

To be sure, there is an entire page devoted to "Arrangements for Oil Supply Emergencies,"<sup>38</sup> and the individual country reports, which average about twenty pages, have one to three paragraphs each devoted to "Energy Security," including oil inventories. Still, the emphasis has not changed much since 1977, when of twelve "Principles for Energy Policy" adopted by the IEA's governing board, coping with a supply disruption was listed eleventh.

Many of the policies followed by OECD countries could be characterized as "buying high and selling low." Most conspicuous is the attempt on the part of governments to increase the supply of liquid fuel which they controlled. The U.S. Synthetic Fuels Corporation is the best example, having spent billions of dollars with only a trickle of capacity, mostly shale oil and gasified coal, brought on-line. Similarly, the Canadian government has spent \$7.5 billion in subsidies through 1985 to promote drilling in the Arctic and Eastcoast Offshore areas<sup>39</sup>, leading to

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<sup>37</sup> International Energy Agency, Energy Policies and Programmes of IEA Countries: 1984 Review, Paris, 1985, p. 4.

<sup>38</sup> Ibid., p. 18.

<sup>39</sup> See "Canada Beset by Huge Cost in Oil Program," Wall Street Journal, 10/31/83, p. 32, which put costs in the first three years of the program (through 1983) at \$4.4 billion. The Canadian Petroleum Association, CPA Statistical Handbook 1983, section IV, tables 6 and 11 shows \$9.8 billion spent through 1983 in frontier areas, half of it since the Petroleum Incentives Program began. The share of expenses covered by PIP has been reported at 80-85 percent.

the discovery of numerous oil and gas fields, only three of which are under consideration for development.<sup>40</sup> The result is that perhaps 250 tb/d of oil equivalent production will be developed, although most of it will be economic only at prices above \$20/barrel of oil.<sup>41</sup>

The Japanese have been active in this regard as well, for similar amounts of money and with greater but still mixed success. The Japan National Oil Company has spent over \$5 billion in support of exploration abroad by Japanese oil companies.<sup>42</sup> However, from a peak of 511 tb/d in 1978, equity production has fallen to 403 tb/d in 1984.<sup>43</sup> In part, this reflects a low success rate in exploratory drilling, which is hardly a policy error. However, the concentration of investment in OPEC countries, especially Indonesia and Abu Dhabi, means that capacity which was developed cannot be produced because of government restrictions. The effect is greatest in Abu Dhabi, where the 500 tb/d Upper Zakum field is being produced at 20% of capacity. The cost of capacity developed under

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<sup>40</sup> The Venture natural gas field off Nova Scotia, the Hibernia oil field off Newfoundland, and the Amuligak oil field in the Arctic. Some discoveries in the Eastcoast Offshore are still being evaluated.

<sup>41</sup> If one assumed that these fields had to bear the entire cost of exploration, then the subsidy would be equal to about \$20 per barrel of oil equivalent (boe). Development-operating costs will probably be \$15-25 per boe, depending on the field.

<sup>42</sup> See "JNOC Mainly Instrumental in Promoting Japan's Exploration and Development Projects," Japan Petroleum Energy Weekly 12/23-30/85, p. 2.

<sup>43</sup> See "Global Exploration by Japanese Gets Help from Tokyo," PIW 2/24/86, p. 4.

this policy has been far cheaper than the Canadian PIP program or the U.S. Synthetic Fuels Corporation.<sup>44</sup>

On the other hand, the Japanese have clearly erred in placing the capacity in unreliable areas, a symptom of the belief in the immunity of one's country from an oil supply disruption, discussed in the section below.

Another aspect of poor commodity strategy has been the tendency for countries to increase their strategic inventories during periods of market tightness, then decrease them when the market weakens. As a result, they (a) worsen oil crises instead of mitigating them; (b) reduce the level of preparedness for future supply disruptions; and (c) lose money through what could only be described as a poor investment program.

Strategic oil inventories, whether government- or company- held, have been employed for decades. Although different countries undertook their own programs at various times, the European Community enacted a requirement that member countries hold inventories totalling 90 days of supply after the 1967 Arab Oil Embargo. Since that time, the IEA has set up a similar policy, and individual countries still maintain their own variations.

However, these have undergone considerable revision over the years, with the amounts held increasing or decreasing depending on a variety of budgetary considerations as well as the perceived market environment. Before the 1979 supply disruption, most European countries' stocks were

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<sup>44</sup> The subsidy itself translates into \$10,000 per daily barrel of capacity, one-third of the potential cost that the Canadian subsidy translates into, assuming all three Canadian frontier projects go ahead. The total spent for exploration and development of this capacity was about three times higher. See JPEW, op. cit.

well under the 90 day floor.<sup>45</sup> After the crisis began, countries tightened enforcement of the inventory floor requirement, increasing demand during the period when the market was tightest. Now that the market is less vulnerable, and prices are lower, most countries are either reducing their strategic inventories or reducing their purchases for them.

The United States is a good example of this behavior. Before the Iranian Oil Crisis, only 91 million barrels were purchased for the SPR. When prices were at their peak in 1981, 122 million barrels were added, the highest for any year. In 1985, with prices weak, only 42 million barrels were added, and plans were made to reduce the amount or cease purchases altogether.<sup>46</sup>

But other countries have behaved in the same fashion, or worse. The French, who added a number of incremental stocking requirements at the height of the Iranian Oil Crisis, are now removing them in order to lower costs to the industry. Since the crisis ended, the government has eased requirements to allow companies to reduce their inventories by 50 million barrels, about one-fifth of their pre-crisis holdings.<sup>47</sup> Sweden and W. Germany have reduced their government-controlled stocks because of

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<sup>45</sup> The level of stocks at the end of 1978 in days of 1978 consumption for the following countries was France (83.6), W. Germany (82.6), Italy (78.7) and Japan (70.4). Since first and fourth quarter consumption levels are higher than the annual average, the days of inventories during the actual period of greatest supply disruption were even lower. See DOE, International Energy Indicators.

<sup>46</sup> See "US Stockpile Buying May Go on After All--at Low Rate," PIW 8/12/85, p. 5. Recently, it has been suggested that the U.S. may take advantage of low prices and make further purchases.

<sup>47</sup> See PIW 9/19/83, p. 6, and 11/11/85, p. 10.

lower demand levels since the oil price increases.<sup>48</sup> Israel is reducing its emergency stockpile by 10 percent (5 million barrels) for budgetary reasons,<sup>49</sup> while lower crude prices at one point reduced the ability of Japan National Oil Company to buy crude for its stockpile, since its revenues were related to the price of crude.<sup>50</sup>

The recent drop in oil prices suggests two things: an opportunity for governments to buy oil for strategic stockpiles at low prices, and the possibility that higher imports will increase vulnerability. Past history suggests, however, that weaker oil prices will make governments more complacent.

#### Fighting the Last War: Policies to Cope with Disruptions

**"Mr. Parra [the former Secretary-General of OPEC] doesn't expect any repetition of the unsuccessful [1967] attempt by the Arab nations to embargo oil shipments to some Western nations. "I don't believe oil can effectively be used as a political weapon by withholding supplies from market--there just can't be an effective selective embargo...."" --Wall Street Interview, 1967<sup>51</sup>**

Since World War II, there have been repeated disruptions in the supply of oil, most minor and technical in nature, but several resulting in substantial price increases. In formulating policy for the possibility of a future oil supply disruption, governments and analysts have almost always focussed on the most recent crisis as a model, and made preparations to deal with a similar disruption in the future. Yet, each

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<sup>48</sup> See Platt's OILGRAM NEWS, 12/29/83, p. 2.

<sup>49</sup> PIW 7/29/85, p. 7.

<sup>50</sup> Petroleum Economist, 10/83, p. 401.

<sup>51</sup> Cited in M.A. Adelman, "Is the Oil Shortage Real? Oil Companies as OPEC Tax-Collectors," Foreign Policy, No. 9, Winter 1972-73, p. 90.

disruption has been different from the last, and the failure of policymakers to anticipate this has often resulted in poor policy formation.

There is one notable exception: the responses to the 1956 Suez Crisis seemed to have brought on the appropriate actions to ameliorate the closing of the Suez Canal during the 1967 Arab-Israeli War. These actions included the construction of tankers large enough to make the Cape of Good Hope route economical, to some extent the construction of pipelines to bypass the Canal, and the maintenance of inventories to cover any short-term oil shortage.<sup>52</sup>

However, the impact of the Suez Crisis on the oil market has largely been forgotten. In fact, oil prices increased by about 30 percent (see Figure 2) as the arrival of about half of Western Europe's oil was interrupted for 13 days, while tankers made the longer trip around the Cape of Good Hope. This was the equivalent of an estimated 15-20 million barrel inventory build as the "pipeline" had to be filled. (See Table 2.)

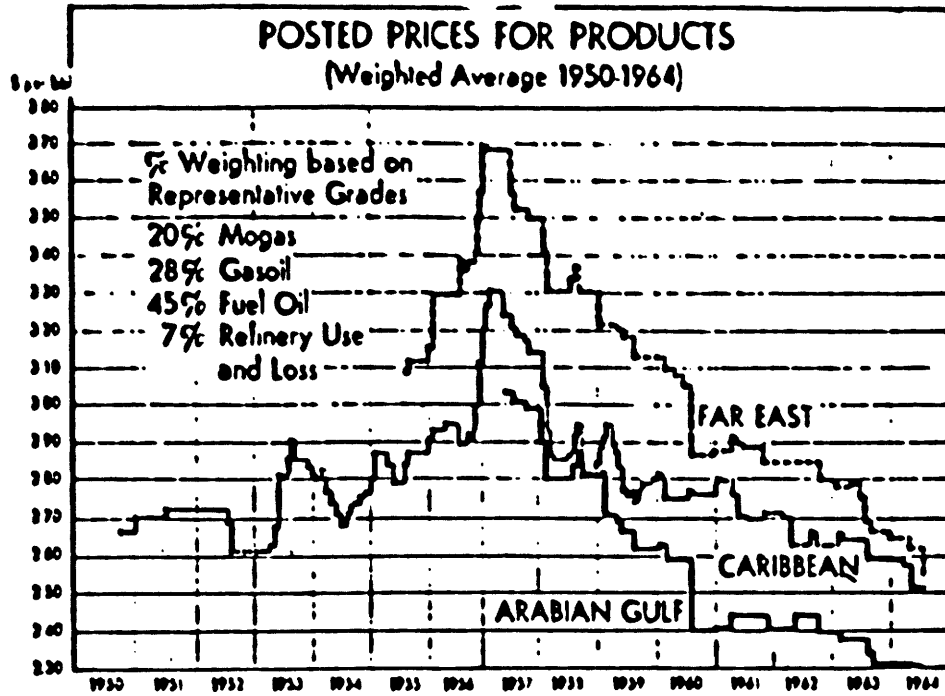
Post 1967 preparations for an oil crisis ignored the changes that were occurring in the market. Oil consumption rose drastically, and by 1973 had increased by 17 mb/d, or 56 percent, and over two-thirds of it had come from the Middle East and North Africa.<sup>53</sup> The market power of OPEC had increased, the dependence of the world economy on oil had increased, and the ability of the producing governments to force their

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<sup>52</sup> See MEPE, vol. 1, p. 1. As with many of the energy security policies pursued, such as fuel switching, there were economic forces at work as well.

<sup>53</sup> BP Statistical Review of the World Oil Industry.

FIGURE 2



Source: Petroleum Press Service, September 1964, p. 329.

Table 2  
Inventory Builds in Past Crises  
(million barrels)

1956 Suez Crisis (tanker fill)	25
1967	
tanker fill	60
onshore	68
1973	
six major countries,	-135
1979	
world	1300
six major countries	667

Sources:

- 1956: Estimated from MEPE, vol. 2, p. C-2.
- 1967: Tanker fill, *ibid.*, on-short fill, *ibid.*, p. F-36 for non-U.S. inventories, MIS 1967, p. 2.
- 1973: Edward Krapels, Oil Crisis Management, Johns Hopkins University Press, 1980, p. 30.
- 1979: DOE, International Energy Indicators; Netherlands, IESR



demands on oil companies had been proven by the price negotiations of the previous three years.

After the 1973 oil crisis, consumers pursued a variety of policies aimed at reducing their oil consumption and preventing future disruptions of their supplies. But most countries felt that supplies could be assured by developing a "special relationship" with one or more producing country governments. The French carried this to extremes, and were, as a result, heavily dependent on Iraq for oil supplies by 1979.<sup>54</sup>

The United States sought to fight any deliberate cutoff rather than appease the producers, and worked for the creation of the International Energy Agency, a sub-organization of the OECD, which was intended to allow consumers to circumvent any embargo. (The French refused to participate, so as not to damage its carefully cultivated relationship with producers.) Its Emergency Sharing System is designed to share the shortfall among members, thus reducing the damage from an embargo and possibly deterring it.

Of course, the subsequent oil supply disruption in 1979 was a byproduct of an unrelated political uprising. Carefully cultivated political relationships proved of no avail as the government of Iran was forcibly removed from office, and the price of oil went up for everybody, regardless of their position (or, indeed, involvement) on the Arab-Israeli conflict. When the Iran-Iraq War began the following year, the French learned the folly of having excess reliance on one source of oil, no matter how friendly the government.

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<sup>54</sup> 22 percent, according to IESR.

### Current Policy Arguments

In the past several years, much of the attention in contingency planning for energy crises has been focussed on inventory behavior, both in the private sector and government strategic stockpiles. The 1979-80 oil crisis heightened realization of the role of private inventory behavior, with the price spike which occurred blamed by some on the inventory increase which occurred.<sup>55</sup> Others have argued for the opposite causality, with rising prices encouraging inventory builds.<sup>56</sup> Whatever the direction of causality, the general perception seems to be that avoidance of inventory build is the crucial strategy to be pursued during the next crisis.

However, this is simply another example of "fighting the last war". That is, the policies suggested are designed to address the problems which appeared during the last crisis, implicitly assuming that those will be the relevant ones during the next crisis. Thus, the current policies being drawn up are intended mainly to deal with oil company hoarding. Aside from questions about the analyses which have been performed, the probability that the next crisis will take on the aspects of the last one, or that the market environment will be similar to that of 1979-80, seems small.

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<sup>55</sup> Albert L. Danielson and Edward B. Selby, Jr., "World Oil Price Increases: Sources and Solutions," The Energy Journal, October 1980.

<sup>56</sup> Philip K. Verleger, Jr., Oil Markets in Turmoil: An Economic Analysis, Ballinger 1982, and R. Glenn Hubbard and Robert Weiner, "The 'Sub-Trigger' Crisis: An Economic Analysis of Flexible Stock Policies," Harvard Energy Security Program, June 1982, H-82-07.

In particular, the possibility that a two-tier market, with small amounts of oil moving at spot prices well above the rest of the officially-priced market, will come into being seems remote. The amount of oil sold by competitive producers (including the now-deregulated U.S. market) has greatly increased, and OPEC producers should move more rapidly to match spot prices next time.

Uncertainty over supplies, the other major theory regarding the inventory build, seems unlikely to be erased by an SPR release. While the government might release all 500 million barrels at 3 mb/d for 6 months, this would hardly solve all problems. In the first place, a crisis could involve much more than a need for 3 mb/d of new supplies (see Table 1). Secondly, the additional supply is not necessarily "certain", any more than the "additional" Saudi production was in 1979-80. Oil companies not only would be uncertain that the U.S. government might cut off the supply at any time (eg., to preserve a strategic minimum) but the reserve would have an obvious bottom, unlike the Saudi supply. (The uncertainty of emergency capacity was been discussed above.)

#### The Profit-Maximizing Theory of Inventory Build

The other major theory which seeks to explain the inventory build in 1979-80 involves analysis performed most notably by Verleger and the Harvard group.<sup>57</sup> The basic argument is that, aside from working inventories, companies maintain speculative inventories. These are increased when the company expects to be able to sell them at a later date for more than their original costs plus the costs of holding them. Future

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<sup>57</sup> Ibid.

average crude prices are estimated to be the current spot price, lagged by the amount of time which Verleger estimated it takes for official prices to reach spot levels.

The flaws in this inventory modelling effort are perhaps best illustrated by the Harvard model. While statistically valid (with an  $r^2$  of .54 and t-statistics of 2.0 to 5.0 for the different coefficients) between 1979 and 1981, the actual performance leaves much to be desired. Out of ten quarterly changes shown, in five quarters the model does not even predict the right direction of the inventory change. Of the five quarters where the sign is correct, two are similar to actual behavior but the other three are all off by a factor of more than two. From mid-1980, the simulation's performance worsens (see Figure 3).

The shortcomings are acknowledged by the group, who cite Verleger's suggestions for his model's failure to achieve statistical significance.

To wit:

" Government policies that require firms to acquire or hold specific levels of stocks, such as the programs in France and West Germany (Deese and Miller, 1981) [and the U.S.];

Government programs that mandate sales from large firms to small firms, such as the U.S. crude oil buy/sell program;

Unanticipated changes in consumer demand that cause unexpected increases or decreases in consumption;

Abnormal weather, such as warm winters or cold summers, that reduces or increases normal demands;

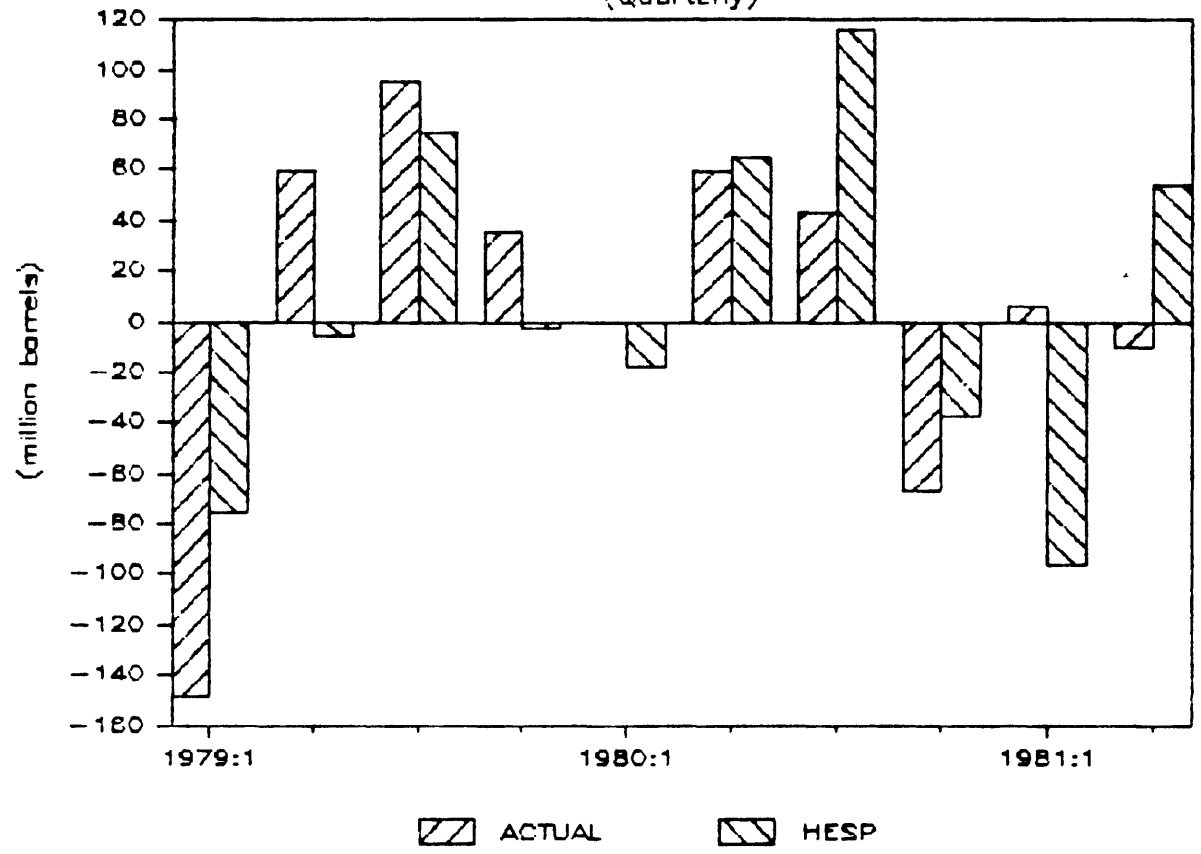
The six-week [sic] shipping lag between loading ports and refineries, which means that a large volume of oil not counted in inventories is inexorably on its way to the tanks of refiners and thus will appear in next quarter's inventories."<sup>58</sup>

This model of market behavior is nonetheless suggestive, and possibly explains part of the inventory build. However, there are other explanations that must be considered. For example, the author

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<sup>58</sup> Verleger, op. cit., p. 120.

FIGURE 3  
 CHANGE IN U.S. PRIMARY INVENTORY  
 (Quarterly)



Source: Hubbard and Weiner, 1982.

demonstrated elsewhere that overestimated consumption may have explained 39 percent of the 1979 inventory build in the United States.<sup>59</sup> As Figure 4 shows, in 1979 and 1980, the overestimate of U.S. demand totalled almost 700 million barrels, far more than the inventory build.<sup>60</sup> Also, ongoing disruptions to the supplies of individual companies through contract expirations, concession nationalizations, etc., may have played a role in the market tightness which occurred.

Even more important is that the market environment has changed. In the United States, price controls meant that holding inventories allowed one to make the aforementioned inventory profits. However, with decontrol, any oil bought at below-market official prices (or controlled 'old oil' prices) could be sold immediately on the spot market, saving the holding costs. As Figure 5 shows, the inventory build in the United States was concentrated in crude oil and gasoline, the two oils subject to price controls. And, as mentioned, OPEC appears unlikely to hold official prices down in the advent of another round of spot market price increases.

#### Conclusions: Achieving Energy Security

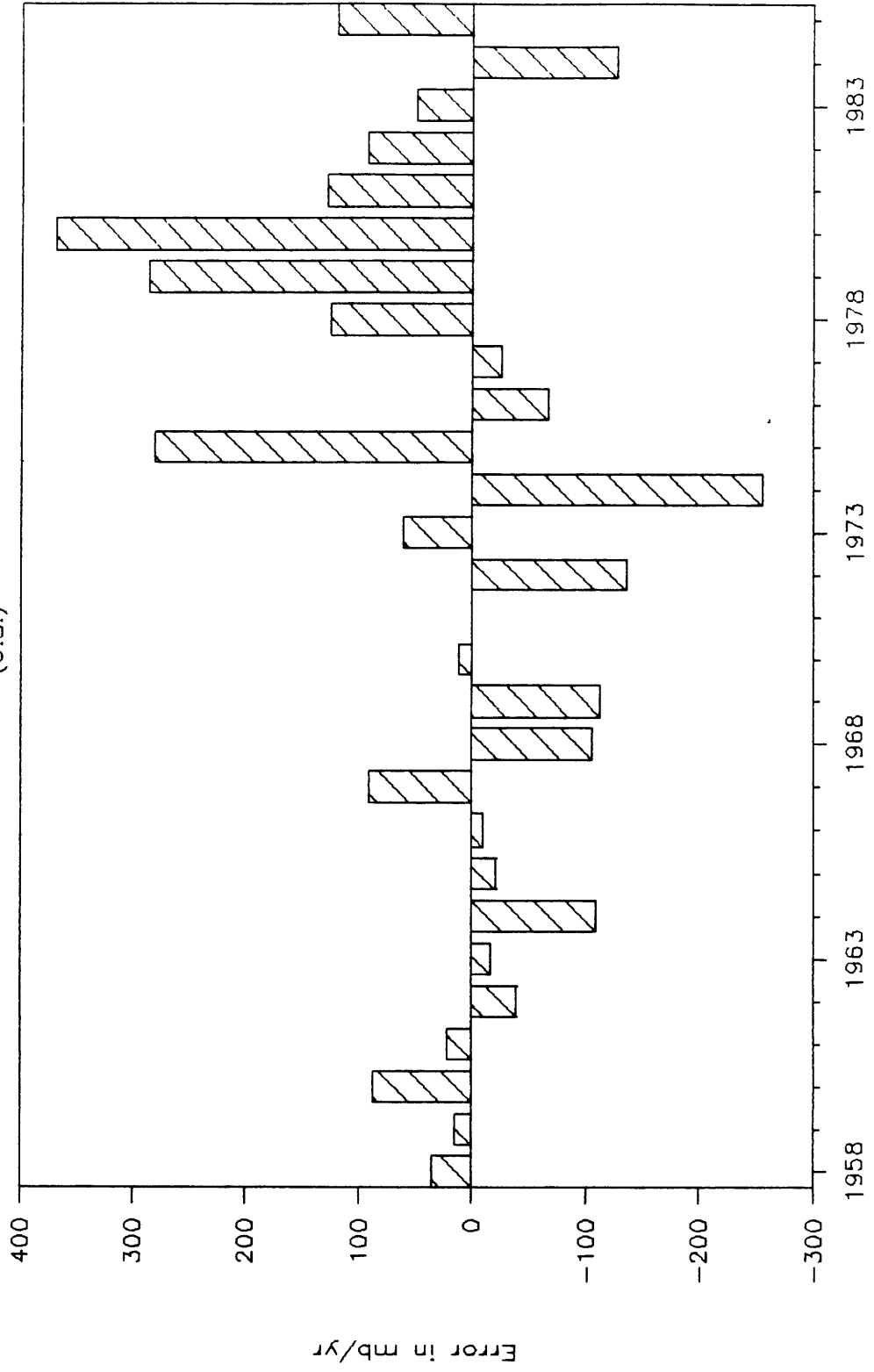
Oil supply disruptions have wreaked enormous havoc on all countries that import oil, that consume oil or that trade with countries that do. In short, all countries except the exporters. But the damage has been

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<sup>59</sup> "Stockpiling: Issues and Experience," in Energy and Security and the State of California. The t-statistics were little better than Verteiger's, however.

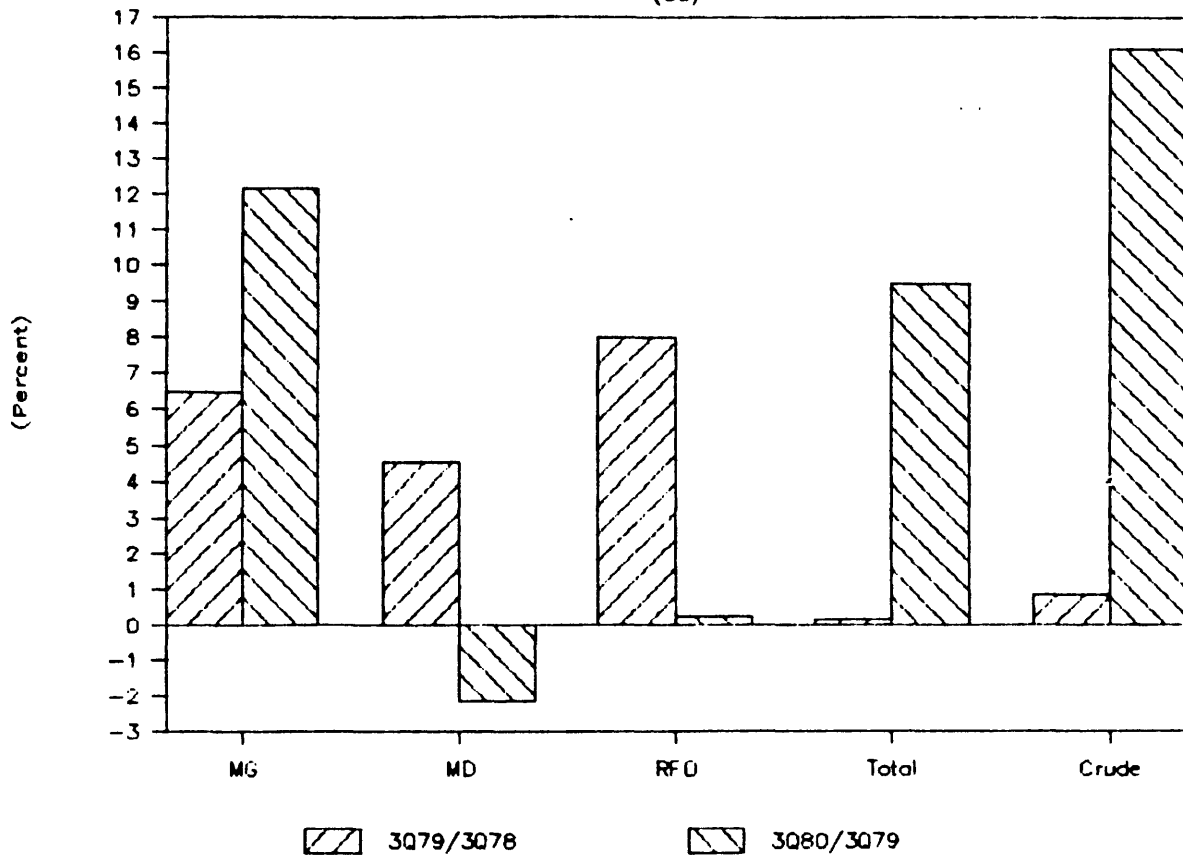
<sup>60</sup> The figure represents forecasted demand minus actual demand, expressed in million barrels per year. Both are taken from the January "Annual Forecast/Review" issue of OGJ.

FIGURE 4  
OIL DEMAND EXPECTATIONS VS. REALITY  
(U.S.)



Source: Oil & Gas Journal, "Annual Forecast/Review," various years.

**FIGURE 5**  
**CHANGE IN OIL INVENTORIES, BY TYPE**  
 (US)



Source: Monthly Energy Review, DOE.

MG = gasoline  
 MD = middle distillate  
 RFO = residual fuel oil



economic in nature, resulting from higher prices, not a physical inability to acquire oil.

Attempts to reduce the amount of oil either consumed or imported will not prevent another oil crisis, since falling production capacity can increase the impact of a given loss of supply. Thus, policies favoring alternative energies and conservation have a limited effect on energy security.

At the same time, policies aimed at dealing with the short-term disruptions that lead to higher oil prices have been shortsighted and focussed excessively on the past, rather than the future. While the world may be more prepared to deal with the next serious disruption in oil supplies, this is far from certain.

In essence, most attempts at achieving energy security have focussed on (1) reducing imports of oil and (2) controlling the source of the imports with the intent of reducing the political influence of the exporter and avoiding any loss of supply.

Yet it has been demonstrated that political influence resulting from economic vulnerability is greatly exaggerated.<sup>61</sup> Sanctions can inflict damage on the target, but rarely achieve the desired political results and usually only when the target is weak. In fact, although oil embargoes have been carried out against a number of nations, including Israel, Rhodesia, South Africa, the Netherlands and the United States, the actual loss of supply to those nations has been minimal, due to the flexible nature of the oil market.

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<sup>61</sup> By far the best source on this subject is Economic Sanctions Reconsidered, Gary Clyde Hufbauer and Jeffrey J. Schott, Institute for International Economics, 1985.

A loss of supply is theoretically possible, but the circumstances necessary for it require a virtual state of war, which call for an entirely different set of policy responses than an energy crisis. Certainly in 1941, when the international oil market was controlled by the United States and Great Britain, an embargo could be effective, but such an environment has not existed for decades and is unlikely to be seen again.

The economic damage caused not by embargoes but from the loss of supply, estimated at as much as \$2 trillion, is the appropriate target of energy security policies. Encouraging conservation and domestic energy production will provide some protection from oil price increases, but such policies must be weighed in these terms, not as protection from loss of supply. The costs and benefits of an import tax can and should be compared with similar policies such as a strategic petroleum reserve.