LEARNING TO DESIGN PLANNING SCENARIOS: THE EXPERIENCE OF ROYAL DUTCH SHELL

by

Pierre A. Wack

1-785-006

Pierre A. Wack
Senior Lecturer
Harvard Business School
June 1984

archives

INTRODUCTION

Most people would agree that the oil industry has been exposed to great changes and turbulence during these past ten years. Furthermore, prior to 1973, oil certainly had seen the most stable and rapid growth of all major industries. Accordingly, it was probably less prepared to face uncertainty and discontinuity.

Yet it is the same condition of turbulence, once accepted as unavoidable, even if unpalatable, that can accelerate management's adaptation to uncertainty and discontinuity. Royal Dutch Shell, for example, which like so many companies had based its planning on forecasts, now starts from the conviction that it is too dangerous and too costly to pretend to forecast the future. Forecasts are dangerous because sometimes, even most of the time, they seem to work. But sooner or later forecasts will fail, and they will fail just when they are needed most: they will fail to anticipate major shifts in the business environment, shifts that make whole strategies and costly investments obsolete.

At the same time a company like Shell needs to form a clear view of the future. The mere size of its investment--it regularly ranks among the top five companies worldwide, and some years is first and the unusually long lead time for most investment decisions (they come to fruition five to ten years after the decision to go ahead, in an environment that is substantially different from that in which the decision was taken) require a clear view of the future. How do we reconcile, then, "It is foolish to forecast the future" with "We need a clear view of the future?" That is the subject of this paper, and in it we describe the evolution in Royal Dutch/Shell of scenarios useful for planning purposes. As will be seen, we finish with a concept of scenarios very different than when we began.

Predetermined vs. Uncertain

Strictly speaking, it is only possible to forecast the future when all its elements are predetermined. What do we mean by predetermined elements? They are those events that have already occurred (or which almost certainly will occur) but whose consequences haven't yet unfolded. For example, if there are extraordinarily heavy monsoon rains at the upper part of the Ganges River basin, one can anticipate with certainty that something extraordinary will happen at Rishikesh, which is at the foothills of the Himalays, within two days; in Allahabad, three to four days later; in Benares, two days after that. This is not fortune telling or crystal-ball gazing, but recognizing the future implications of something that has already occurred.

This careful sorting out of the predetermined elements, this identification of what has already happened, is basic to serious planning. But great care is needed with the predetermined. As Paul Valery said, "Un fait mal observé est plus dangereux qu'un mauvais raisonement." ("A poorly observed fact is more dangerous than a wrong reasoning.") It can be said in American, too.

Sometimes the share of predetermined elements is large, sometimes it is small, but very seldom is it large enough that a single-line forecast will suffice. And a single-line forecast for a situation that is not fully predetermined is an intellectual swindle. Decision makers facing uncertain situations have the right to know that it is uncertain. Some decisions are always going to remain a gamble, but it is dishonest to lead a manager to believe that he or she faces a safe, business-as-usual type decision. Therefore, it is essential to try to put as much light on the uncertain elements as on the predetermined elements. They should not be swept under

the carpet. And for coping with the uncertain part of the business environment, we have tried to accumulate experience over the years in the use of scenarios.

The word scenario can have many meanings. This paper deals with scenarios useful for planning purposes and illustrates how we gained some understanding of the art of scenario design, by using two examples from the past. The first came from the oil shock of 1973. Since everybody knows what happened, it is a good context in which to appreciate the strengths and limitations of scenarios as a tool for dealing with uncertainty and discontinuity. But primarily, this case was selected because we were really experimenting with the scenario technique and probably learned more from our mistakes than from our successes. As will be seen, we finished with a concept of what scenarios should be that differed substantially from our initial ideas. The second example describes our first application of scenarios to the short term. This case, performed in 1975, benefited from our accumulated experiences and the scenarios were better designed.

BRIEF HISTORY OF PLANNING AT SHELL

Shell's planning processes between 1945 and 1980 are outlined in Exhibit 1. As indicated, from 1945-1955, most of the planning was physical. The Second World War had brought much destruction and the demand for oil was high. The company needed to build new production capacity, tankers, depots, pipelines and refineries. The main challenge was to schedule new facilities to be properly coordinated in time, and a PERT style of approach was used. Almost no economic planing was needed during this decade.

STEPS IN THE PLANNING APPROACH IN SHELL

1945-55: MAINLY "PHYSICAL" PLANNING

1955-65: PROJECT PLANNING + SELECTIVITY

1965-72: UNIFIED PLANNING MACHINERY

1967 : YEAR 2000 STUDY

1969-70: HORIZON YEAR PLANNING EXERCISE

1971 : EXPERIMENTAL USE OF SCENARIOS AT THE CENTRE

1972-73: INTRODUCTION OF SCENARIO-PLANNING

1975 : INTRODUCTION OF MEDIUM-TERM CYCLICAL SCENARIOS

1976-77: DEEPENING "SOCIETAL ANALYSIS" IN PLANNING

1978-79: DEEPENING "GEOPOLITICAL" AND "POLITICAL" RISK ANALYSIS

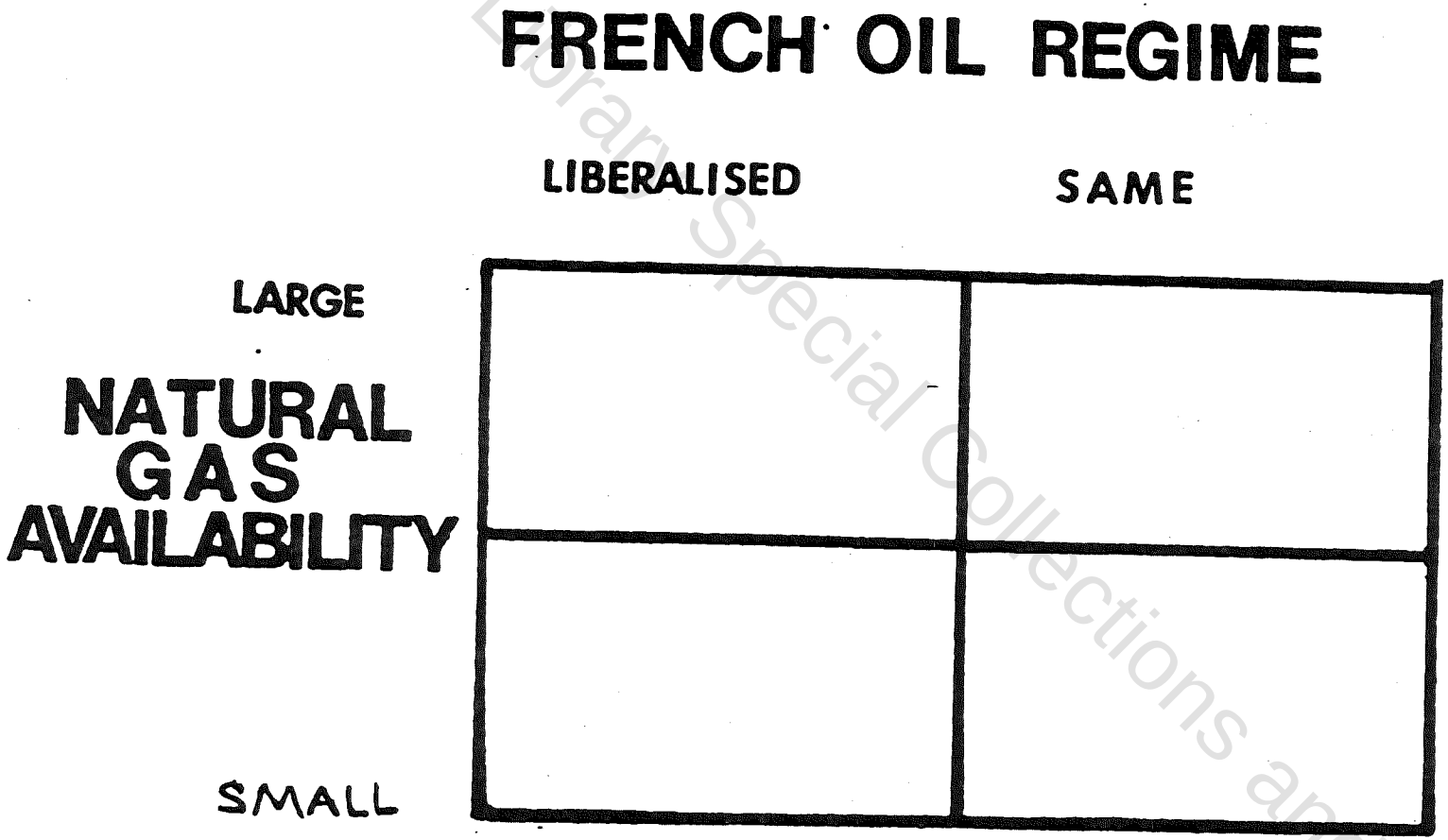
1979-80: A FRESH LOOK AT THE VERY LONG TERM + DEVELOPMENT OF PLANNING CAPABILITIES INSIDE THE GROUP

In the next decade, 1955-1965, financial considerations became steadily more important, but largely on a project basis: the economics and the prospective rate of return on any given project were searched and appreciated. At the same time, Shell introduced selectivity in its downstream sales objectives, choosing to develop those products and marketing channels that were most financially attractive, but with no real integration upstream in crude oil production activities.

In 1965, Shell introduced a new system rather pompously called "Unified Planning Machinery" (UPM) to provide integrated figures for the whole chain of activity--from the oil in the ground, to the tanker, to the refinery, all the way to the gas station on the corner. UPM was a sophisticated, worldwide system that looked ahead six years (the first year in detail, the next five in broader lines) but was designed, unconsciously, for a familiar, predictable, stable world. As six years was clearly a short horizon for an oil company, soon after the introduction of UPM in 1967, a study to explore the business environment of the year 2000 and Shell's corporate position in it was initiated.

The Year 2000 Study revealed that the familiar, surprise-free environment simply could not continue, certainly not through the second half of the period considered. The oil market would switch from a buyers' to a sellers' market, with major discontinuities in the price of oil and in the resulting inter-fuel competition. The projected magnitude of the world oil and gas business also signified that major oil companies like Shell would become extremely large, heavily committed and much less flexible--in a word, ill-placed--to adjust rapidly to such sudden changes in the structure of the oil and energy markets.

FRENCH OIL REGIME



Horizon Year Planning

The results of the Year 2000 Study generated a one-time exercise called Horizon Year Planning (1969-1970). A dozen of the largest Shell companies throughout the world along with the main "sectors" at headquarters (such as exploration and production, and marketing), were asked to look ahead fifteen years, to 1985. It was through this exercise that I first encountered scenario planning.

One of the participanting companies in the Horizon Year planning exercise was Shell Francaise, for which the author worked at the time. We were familiar with their scenario approach, early championed by the Hudson Institute, and interested in experimenting with it. France was a perfect testing ground, for there were two major uncertainties. The first was the availability of natural gas discoveries had been made in France and Holland), the only fuel that could compete with oil and even displace it. The quantity available would have a profound impact on the prospects for oil consumption. We did not know how much gas actually would be available and could only develop high and low estimates. The second uncertainty was political. France at that time operated under an oil regime that favored French national companies and severely limited Shell's market share in the country. France, however, was now a member of the Common Market and might have to change its oil regime to conform to EEC policy. We had two options: France's oil regime would remain largely unchanged; or it would end after the transition period provided by the Treaty of Rome instituting the European Common Market. Combining these alternatives with the natural gas uncertainties gave us four scenarios (Exhibit 2). It was at this point that we began to make some discoveries.

First, we recognized the sheer amount of time needed for scenario planning. We tried to provide the same sort of detail for each of the four scenarios that we would have devoted to a normal UPM plan--naturally, it took nearly four times as long. We could not, in fact, finish all the plans in time. It was clear that the same level of quantification and detail was not possible when planning with multiple scenarios. In an army, the logistics of supplies have to be adapted to the type of war being fought. In scenario planning, the logistics--the capacity to deal easily with a number of alternatives--have to be properly developed (in fact to be made overdeveloped) or the whole process is paralyzed by this bottleneck. In practice, this means either flexible simulation models and/or a number of specialists in key areas capable of rapidly assessing the consequences of different alternatives in a given field. We later found both qualities were needed.

Another realization was that simply combining obvious uncertainties was not helpful for decision making. Uncertainties merely added together lead to evident conclusions in terms of strategies, usually simplistic and unreconcilable, which do not seem to justify such a time-consuming planning process. Worse, management feels locked in by uncertainties, trapped in the quadrants of the scenario matrix. The real benefit of such scenarios is not as a decision tool but as a search tool, leading to a deeper understanding of the interplay of factors shaping the dynamics of the situation, and paradoxically to the emergence of some certainties, "inevitabilities," underlying the basis of the situation. We intuited--we hadn't yet learned it--that the obvious scenarios we had developed were merely "first generation scenarios" useful in gaining a better understanding of the situation to develop better "second generation

scenarios" later. This dawning intuition, confirmed by all later experiences, was the awareness of the critical importance of design: scenarios will be of help to the decision maker or are of no use to him, depending on how they are constructed and presented and not just on the informatin they contain. It is like architects who, with the same basic materials, can create a well- or poorly-designed school or hospital.

Although the initial attempt at scenario planning was not a success, it whetted our appetites. We believed the technique had promise and wanted to continue using it.

Meanwhile, the Horizon Year exercise fully confirmed the conclusions of the Year 2000 Study. The most important ones follow.

- While long characterized by a considerable oversupply, the oil market was due to switch to a sellers' market.
- Soon there would be virtually no spare crude oil supply capacity in the secure, stable areas such as North America.
- Inevitably the Middle East, and in particular the Persian Gulf, would be the balancing source of oil supply. In order to satisfy the estimated world demand for crude oil, some 53M b/d would be required from the Middle East by 1985, compared to the 14M b/d in 1970. (This forecast allowed for discovery rates outside the Middle East some 40 percent higher than those achieved during the 1960s.)
- The very high demand on Middle East production would bring a sharp reduction in the Middle East reserve-to-production ratio.
- It seemed likely that this very sharp peaking in the Middle East production would not in fact be allowed to occur and that many other factors would intervene, including:

a. A desire by Arab countries to stretch out the lifetime of their one valuable resource.

b. A cornering of the world energy market for perhaps ten to fifteen years by limiting production.

- Something approaching a sustained worldwide depression would be necessary to reduce the growth of demand for the Middle East oil to levels where the anticipated sellers' market would be too weak to command substantially higher oil prices.

After the Horizon study was completed, the Royal Dutch Shell managing directors raised serious doubts about the UPM's ability to provide realistic assumptions for the planning process: "How could a planning process provide the right answer if the forecasts on which it is based are likely to be wrong?" They decided to try scenario planning as a better framework to think about the future than forecasts, which were perceived as a dangerous substitute for real thinking in times of uncertainty and potential discontinuity. That was in 1971. But Shell is a prudent company: during the first year, when the committee of managing directors experimented with the idea of scenario planning, the UPM continued in operation throughout the company. In 1972, scenario planning was extended to headquarters and selected large national Shell operating companies, and in the following year scenario planning was advised throughout the corporation. At that time UPM was phased out.

EXPERIMENTAL USE OF SCENARIOS

Our next task at Shell was to discover how to go from a "first generation" type of scenario to a type that could become the basis for action.

We started with what we termed a "surprise-free" scenario which is also by definition a "consensus forecast." The surprise-free scenario is one that nowadays rarely comes to pass but in my experience is essential to have in the package. It builds on the implicit views of the future shared by most managers, making it possible for them to recognize their outlook in the scenario package. If all possibilities appear alien to the participants, they are likely to find the scenario process threatening, and reject it all out of hand. Moreover, the surprise-free scenario permits a clearer perception and fuller internalization of different perspectives later on, when these are compared with the current implicit view.

For the scenarios prepared in 1971, we focused on three key dates in the future, 1976, 1980, and 1985. We chose 1976 because the Teheran Agreement, establishing the level of producer-government taxes for OPEC, was to be renegotiated at the end of 1975. We anticipated that there would be a change in the percentage take required by oil-producing nations. The dates 1980 and 1985 were chosen arbitrarily to allow us to look out on a reasonably distant horizon.

The data used in our first-generation scenarios came from earlier UPM planning documentation developed in 1970 and 1971. We assumed median economic growth, leading to a 1985 energy-demand forecast of the equivalent of 154M b/d of oil. This was slightly higher than the 1971 estimate, which had a median of 150M b/d and a range of 140 to 165M b/d. We settled on 154, a bit on the high side of this range, because recent UPM forecasts had been consistently underestimating demand. Thus the surprise-free figure in Scenario I fit very well with people's overall expectations at the time.

For the next two scenarios we combined, in opposite proportions, the two obvious uncertainties that our horizon year exercise had perceived

1971 Scenarios

I	II	III	IV
Surprise-free Scenario	Low Demand High Govt. Take	Very Low Demand Low Govt. Take	Other Energies Intensive Scenario

in our business environment: the level of producer-country take per barrel of oil, and the overall rate of economic growth and hence of oil consumption.

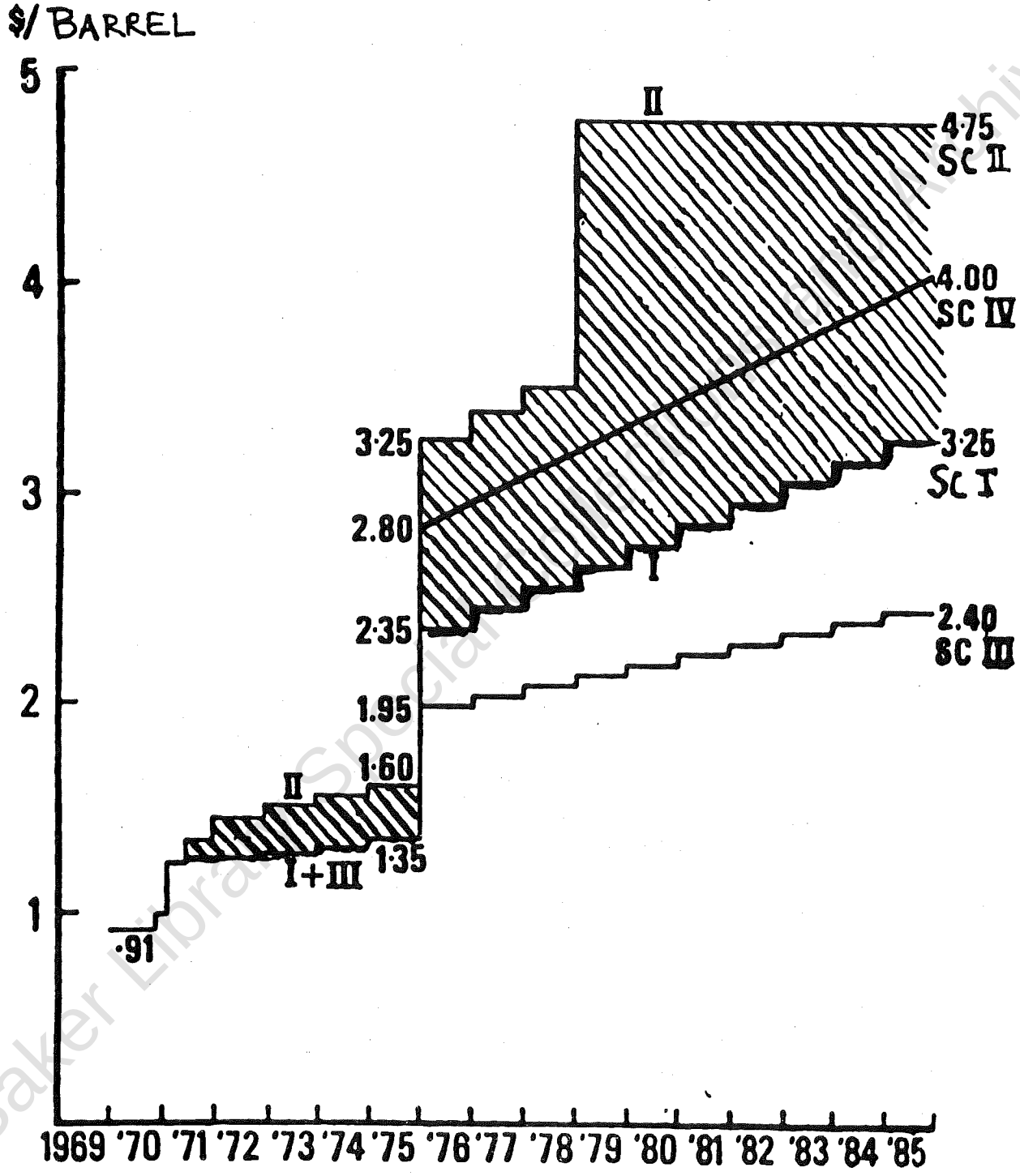
Scenario II was based on a great increase in host-government take. We assumed that the renegotiated Teheran Agreement would result in tripled producer-nation taxes, in real terms, in 1976, and that this take would be quadrupled in 1980. Exhibit 4 shows our estimates of producer-government take under all four scenarios, with Scenario II at the top of the chart. This assumption would result in rising prices that would depress economic growth after 1976 and oil demand even more. In 1985, in this scenario, energy demand would be 13M b/d lower and oil demand 24M b/d lower than forecasted by the surprise-free scenario.

Scenario III was the opposite: it was based on very low economic growth. 1970 and 1971 were years of below-average economic growth, and the preceding years had seen increasing emphasis on "me-first" non-work-oriented values. The slow-growth scenario extrapolated these attitudes: the rate of economic growth in the surprise-free scenarios was nearly halved in Scenario III. International trade was forecasted to grow at a decreasing rate, due to nationalism and the imposition of tariffs. In this world, the price of crude oil could not rise very much, and producer-government take would increase even less than in the surprise-free world. The Teheran Agreement, we assumed, would simply be renegotiated at a somewhat higher level. (See Exhibit 4.) Scenario III yielded a 1985 energy-demand level of 34M b/d less than Scenario I (surprise-free).

Scenario IV postulated a high development of other energies, in particular coal and nuclear. These two forms of energy were expected to

PRODUCER **Government Take 1970-1985**
(constant 1970 dollars)

4



account for 11M b/d more in oil equivalence in Scenario IV than in Scenario I.

The table below shows 1985 demand levels under each of the four scenarios, and indicates the size of anticipated sources of supply.

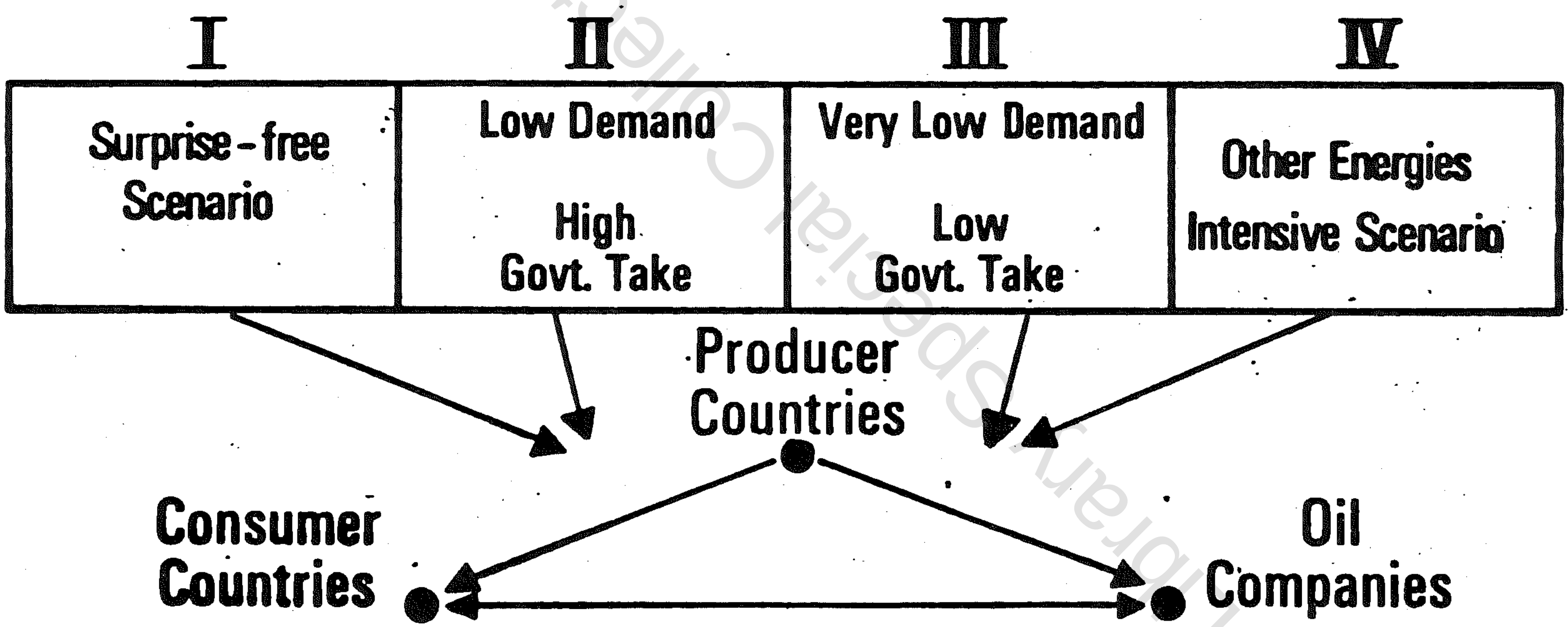
	M/M B/D Oil Equivalents			
	I	IV	II	III
Total 1985 Energy Demand	154	154	141	120
Supplied By:				
Oil Fuels	87	75	63	56
Coal-Nuclear	36	47	47	35
Hydro-Natural Gas	31	32	31	29

As can be readily seen from the table, the range of demand was wide, from 120 to 154M b/d. The required quantities of oil fuels (excluding the portion of oil devoted to chemical feedstock and other nonfuel applications) ranged from 56 to 87M b/d.

In appearance, this set of scenarios seemed reasonably well designed. They covered a wide span of possible futures, each of them internally consistent, and would fit most definitions of what scenarios should be. Yet such scenarios were useless for decision making: they had no teeth, were incapable of mobilizing a management team to action, and were merely "first generation" scenarios. We showed them to our committee of managing directors in a short presentation just to make sure that the scenarios covered reasonably well the range of uncertainties considered relevant. There was not the smallest spark of real interest in the audience, because no strategic thinking, no plans, could be made on the basis of this material. And this is the point at which many companies

5

1971 Scenarios



cease their attempts to employ scenarios in planning, a point at which no serious action can occur. The scenarios here are like a river unable to reach the sea; their force is confined and ineffectual.

Nonetheless, one important insight did emerge from this preliminary overview: in all four scenarios, oil demand was equal to, or less than, that postulated by the surprise-free scenario. We were unable to build a scenario in which demand was higher than in Scenario I, and that in itself was remarkable. In the past, our demand forecasts always needed to be raised as time went on, and indeed Shell at this very time was busily building new refineries and greatly adding tanker commitments. This insight alone, however, was not sufficient to convince our managers that we had discovered anything very significant.

The purpose of these exploratory, first-generation scenarios was not action but understanding: to gain insight into the system, to identify the predetermined elements, and to perceive the connections among various events and forces driving the system. Furthermore, in addition to identifying predetermined elements, we also became aware of others not obviously predetermined, but which became predetermined as a result of the interrelatedness of the system as we had come to understand it. In this way we learned of many outcomes that were simply not possible under any reasonable set of assumptions. Thus, our exploratory scenarios became excellent search tools. They had yet to become effective planning devices.

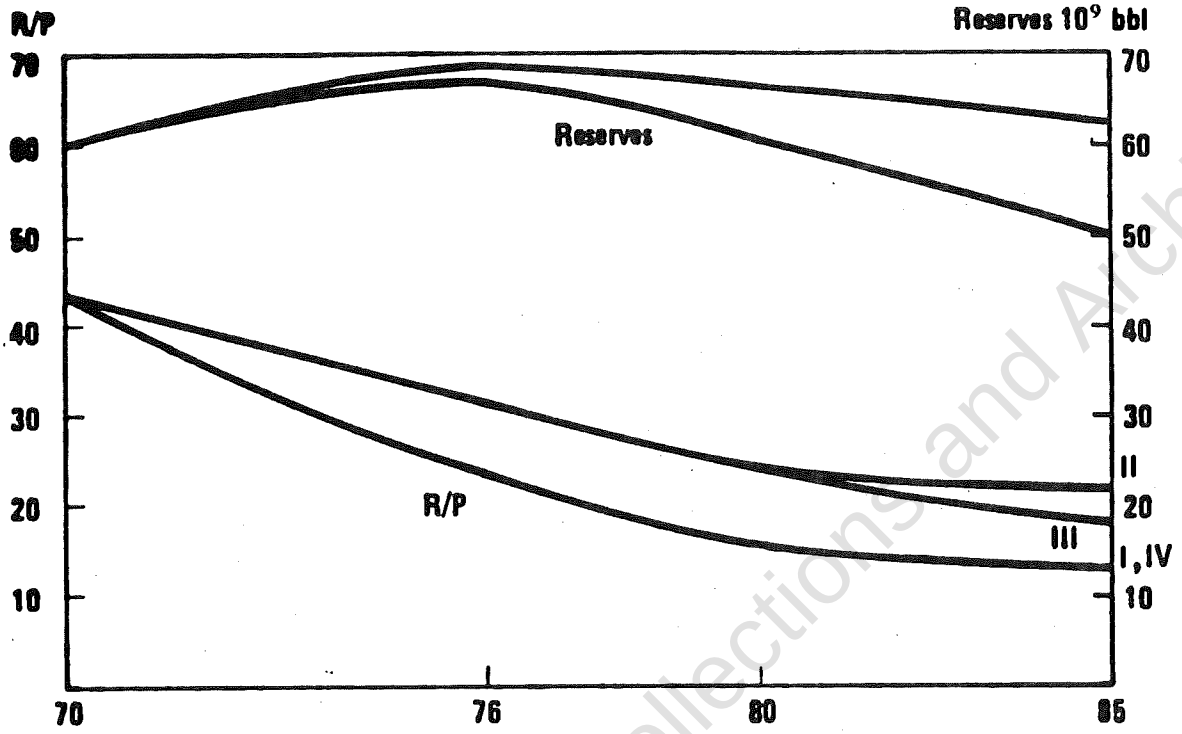
The Triangle Study

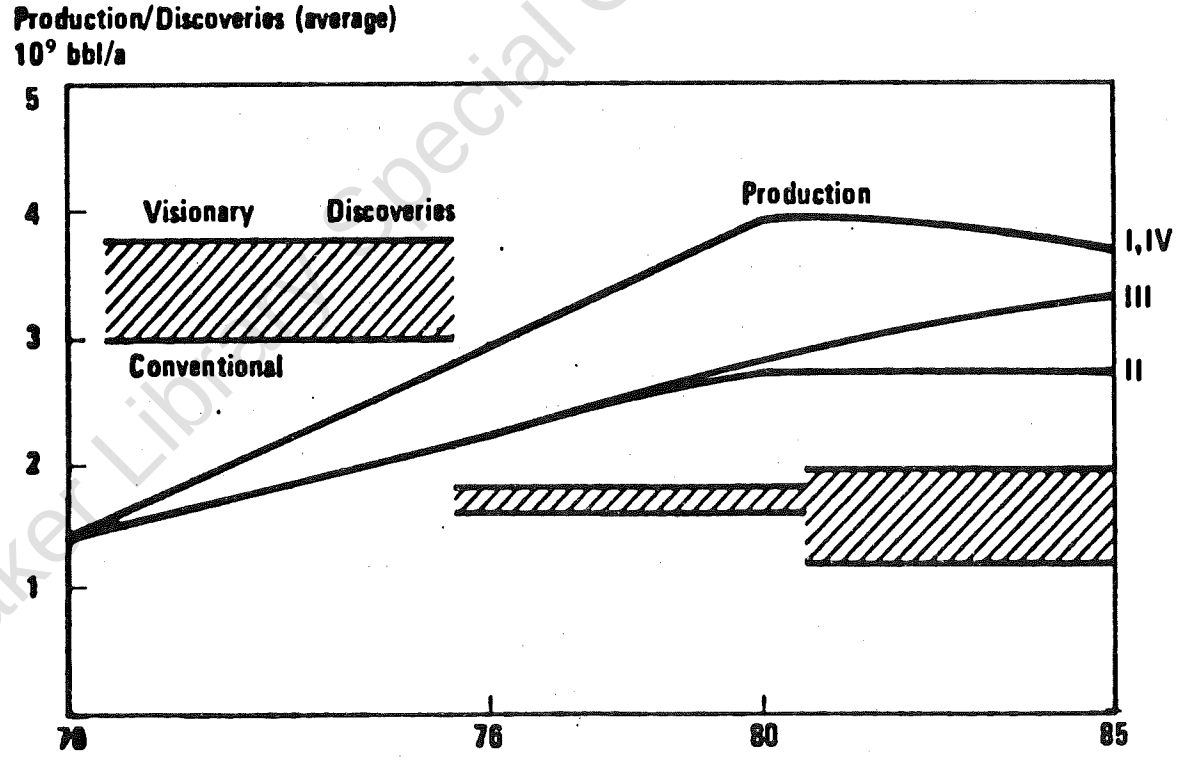
Our next step at Shell was to embark on several new studies based on our four exploratory scenarios. The most important was the one we called the "Triangle Study," in which we attempted to understand the behavior of the three major actors in our business environment. Exhibit 5

IRAN

RESERVES/DISCOVERIES/PRODUCTION

6





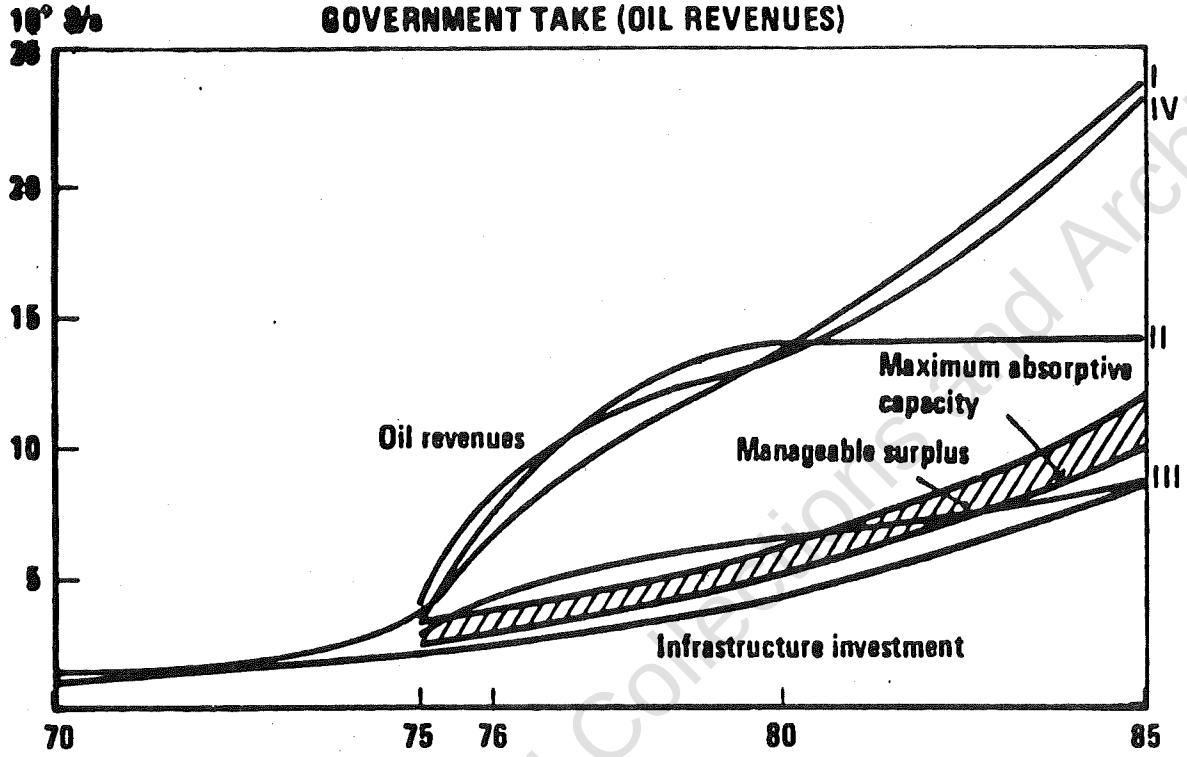
shows these three actors, each at an apex of the central triangle. At the top appear the oil producer countries, on the left the oil consumer countries, and on the right the oil companies. Although they are shown together in the chart, we knew it was essential to treat each of these aggregates unit-by-unit, because their behavior would be determined by situations specific to themselves and not necessarily shared with others in their group. For example, by producer countries, we did not mean OPEC and non-OPEC in general, but individual major oil producing countries, as the strategy of Iran would differ from that of Kuwait or Nigeria. And, the oil companies included the seven major companies, independents and government companies, and those new firms that were soon to become active in the oil market, like the Japanese trading companies.

Exhibit 6 shows our analysis of Iran at that time. In the lower part of the chart, in lines, is the anticipated production under each of the four scenarios. The shaded areas show our expectations of discovering new oil reserves in Iran and are expressed on a five-year average using a probability curve. The low line of each shaded area is the center of our expectations (50 percent chance to be higher; 50 percent chance to be lower), with our "visionary" expectations at the top of the probability curve. In the first five-year period we anticipated more new oil would be found in Iran than Iran would be producing under any of our four scenarios. In the next two periods, however, the situation is reversed: Iran would be producing more oil than we expected to find. This situation is reflected in the upper half of the chart, which shows Iran's reserves at the top line, and below the reserve/production ratio which would start to drop rapidly as the 1970s advanced. We believed that when Iran began to recognize this reserve/production drop, its policy of expanding production

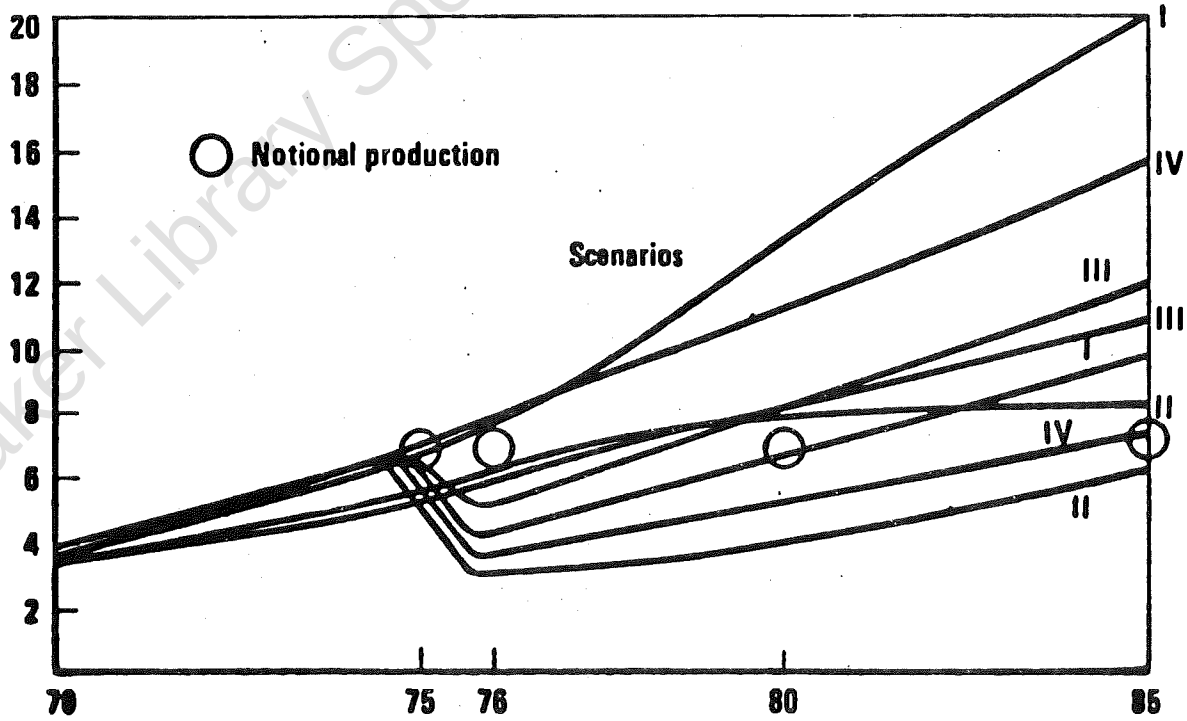
SAUDI ARABIA

(Incl. 50% N. Zone)

MAXIMUM ABSORPTIVE CAPACITY
INFRASTRUCTURE INVESTMENT POSSIBILITIES
GOVERNMENT TAKE (OIL REVENUES)



PRODUCTION LEVELS FOLLOWING FROM SCENARIOS AND MAXIMUM ABSORPTIVE CAPACITY

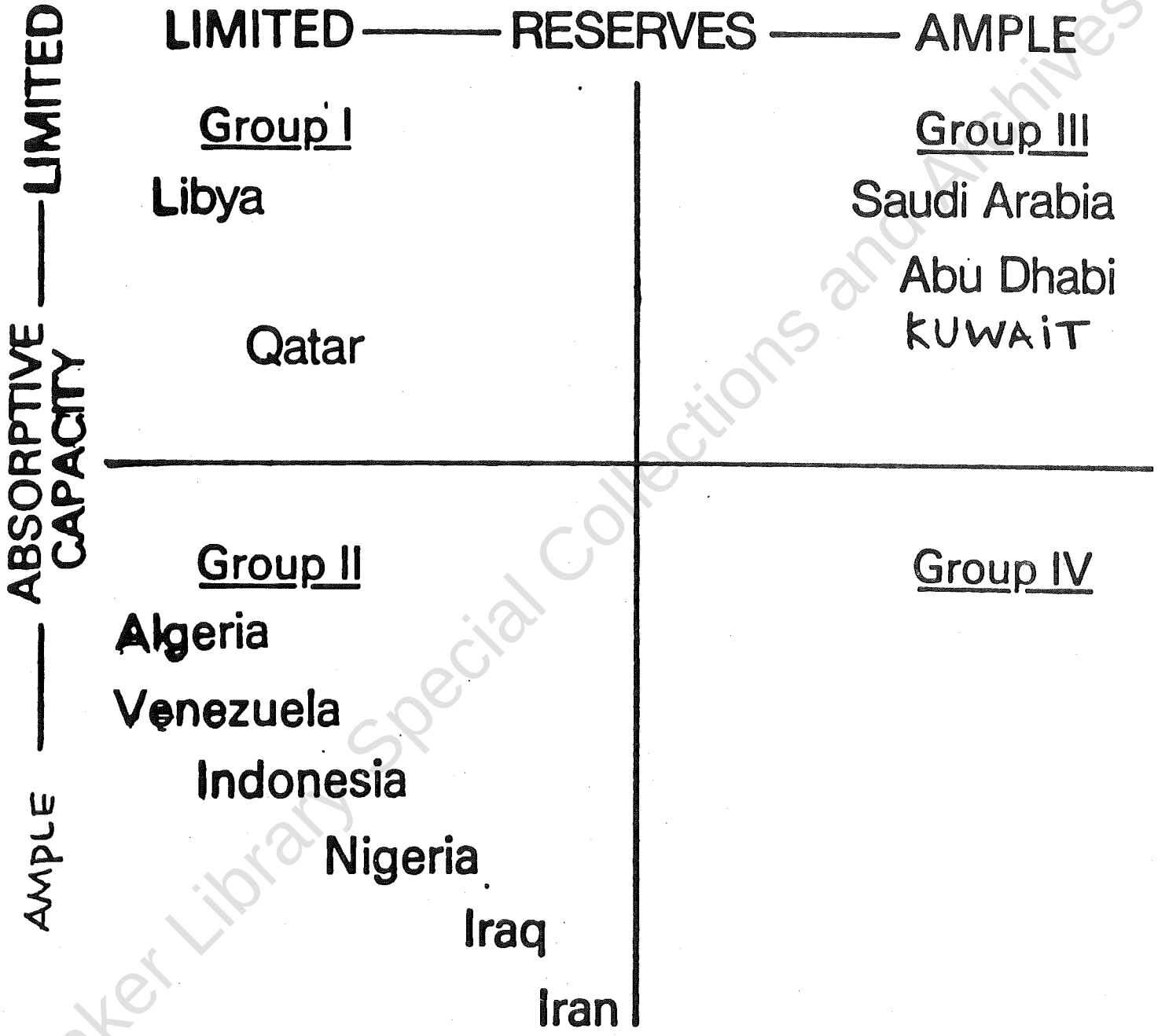


would change. Instead of aiming at increasing volume, Iran would aim at increasing prices. This change in behavior would derive not from some anti-Western shift of attitude, but simply from the logic of the situation: if we were Iranian, we would react similarly.

An entirely different situation is illustrated in Exhibit 7, the charts pertaining to Saudi Arabia. The upper chart shows Saudi Arabian revenues as foreseen by each of the four scenarios. In all cases except the gloomy exploratory Scenario III, Saudi Arabia retains far more oil revenue than it can meaningfully absorb. "Reasonable Surplus" appears on the chart as the shaded area; again except under Scenario III, all the scenarios lead to a surplus in excess of Saudi Arabia's ability to absorb it. In the lower chart, production, as envisaged in each scenario, appears in black. Notice that Scenario I, the surprise-free implicit view prevailing in an oil company, calls for 20M b/d in 1985--a politically difficult-to-believe outcome. The chart shows in red the production necessary for Saudi Arabia if that nation wished to generate only the revenues it was capable of absorbing. From these charts we were led to believe that the Saudis' logic would, in the end, prevail upon an oil company logic. It was not altogether surprising, therefore, to read in Platt's Oilgram of February 10, 1972, the following quote by Ahmed Yamani, Saudi Arabia's Minister for Oil Affairs:

> Inability to spend our surplus income inside our own countries will lead us to reconsider the value of keeping our revenues in the banks and realizing interest on them as compared with the appreciation in the value of our crude oil if it were to be left in the ground. We should find that leaving our crude in the ground is by far more profitable than depositing our money in the banks, particularly if we take into account the periodic devaluation of many of the currencies. This reassessment would lead us to adopt a production program that ensures that we get revenues which are adequate for our real needs.

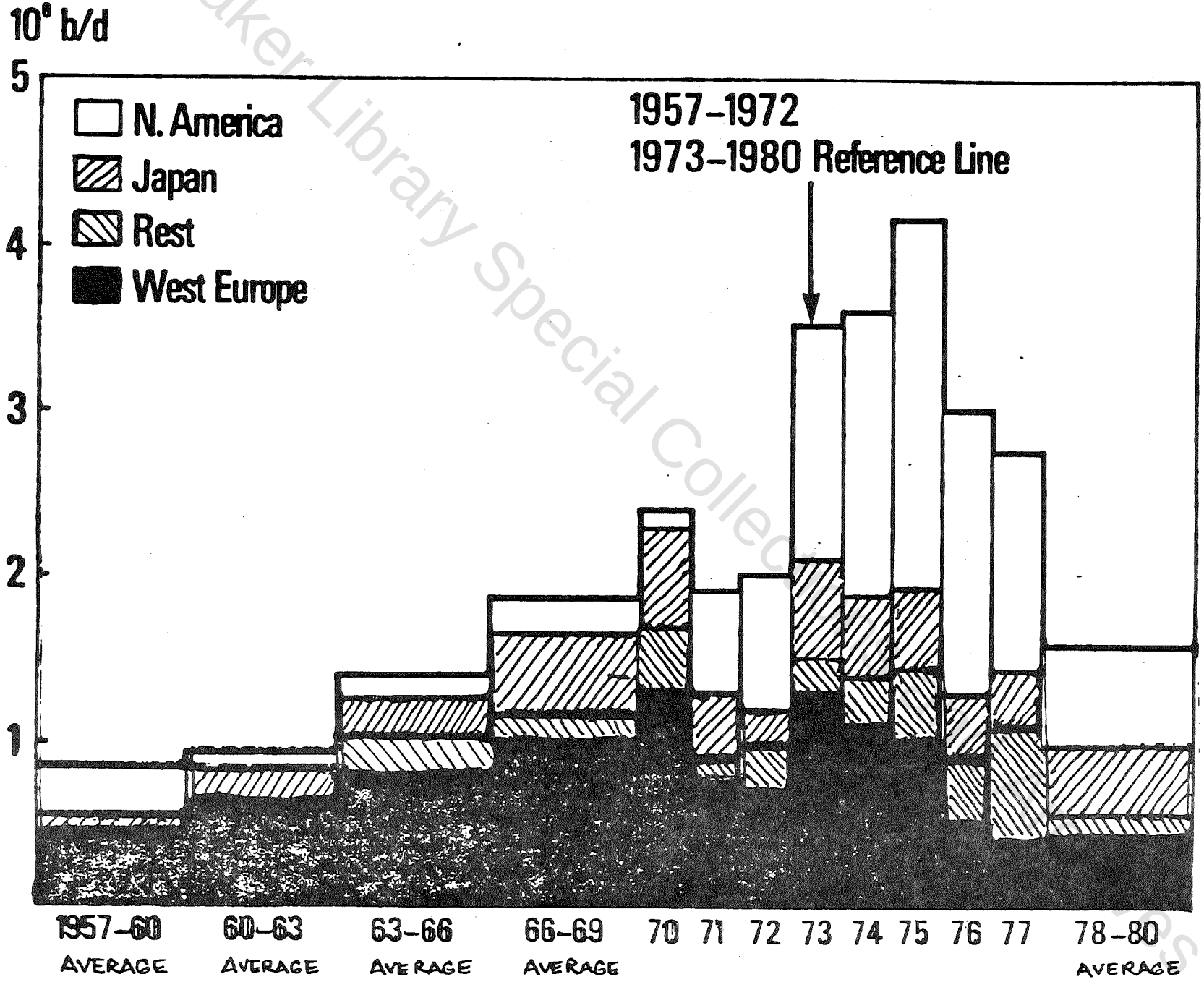
THE MAJOR OIL EXPORTERS



The simple matrix in Exhibit 8 plots countries according to their oil reserves and absorptive capacity for oil income. One fact, heavy with consequence, emerged clearly: no oil-exporting nation had both ample reserves and ample absorptive capacity, and thus no nation appeared in the fourth, empty, quadrant. The oil situation would have been quite different, if, say, a nation with Indonesia's need for funds had the reserves of Saudi Arabia. But this was not the case. The Soviet Union might someday find a place in the fourth quadrant--but at a much higher price level for oil than the one then prevailing, as most of Russia's potential oil would be very costly to develop.

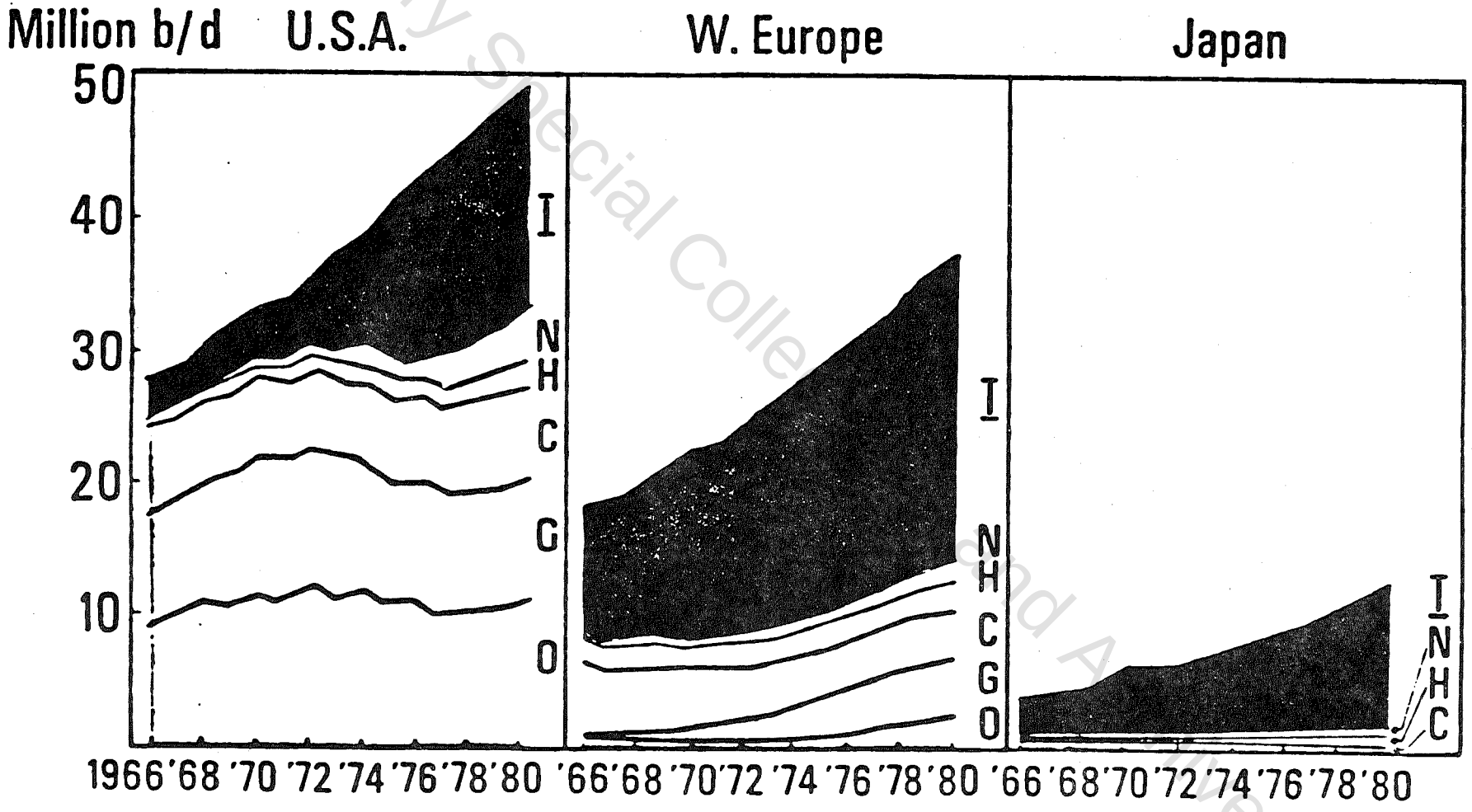
To give another example of "identifying heavy monsoon rains in the upper part of the Ganges River," analyzing the oil-consuming countries (the left corner of the triangle in Exhibit 5), we can see in Exhibit 9 the annual increments in import requirements of the major oil-consuming countries. For many years, oil imports had increased at about 1M b/d. Then for a long time the rate of increase was about 2M b/d. Suddenly, however, in the middle 1970s, oil imports were expected to increase annually at much higher rates. These sudden changes can be understood by looking at Exhibit 10, which shows the sources of energy supply in the United States, West Europe, and Japan. In the U.S., oil had peaked early, and the incremental demand for energy had been satisfied by natural gas. Because of its regulated price, however, natural gas production plateaued in about 1972. Coal production might have increased, but in light of the perceived future for nuclear power, coal resources were not being developed. Nuclear plants were not yet functioning in enough numbers to meet the incremental demand, which was increasing annually at a substantial pace. Since the base was so large to begin with, even a 3 to 4 percent

Annual Growth in Import Requirements



Energy Demand by Sources
(Reference Line)

I=Imported Energy Indigenous {N=Nuclear; H=Hydro-Electricity; C=Coal; G=Natural Gas; O=Oil



increase in the U.S. energy demand meant a great deal of the only available incremental energy source--imported oil.

In Japan the phenomenon was somewhat different. Japan was like a new continent emerging on the world economic map. In 1953, at the end of U.S. occupation, Japanese industrial production was 40 percent of U.K.'s level. In 1970, it was more than double. The country was growing at 11 to 12 percent a year, with a very oil-intensive economy. When the economy grew at 11 percent, oil demand grew by as much as 20 percent. This large oil elasticity coefficient, combined with Japan's rapidly growing economic size, created huge increases in that nation's oil imports (see Exhibit 10).

The volume quantity aspect was important, but there was a behavioral element that was also critical. For example, multinational oil companies were all accustomed to dealing with the Middle East. But now there were newcomers, new American companies with little experience, which could be anticipated to be weak links--and, in fact, they became just that. Also, with Japan, one could anticipate a certain behavior. The Japanese were always overanxious if anything important coming from the outside ran the risk of being denied them. The Japanese could be expected to be overanxious about any tension in oil supply. Furthermore, they would project onto multinational oil companies the type of behavior their own companies would normally have in a crisis situation: being loyal only to the home country and ignoring the rest of the world, and this would add to their overreaction. Such nonquantifiable data was as important to us as volume information.

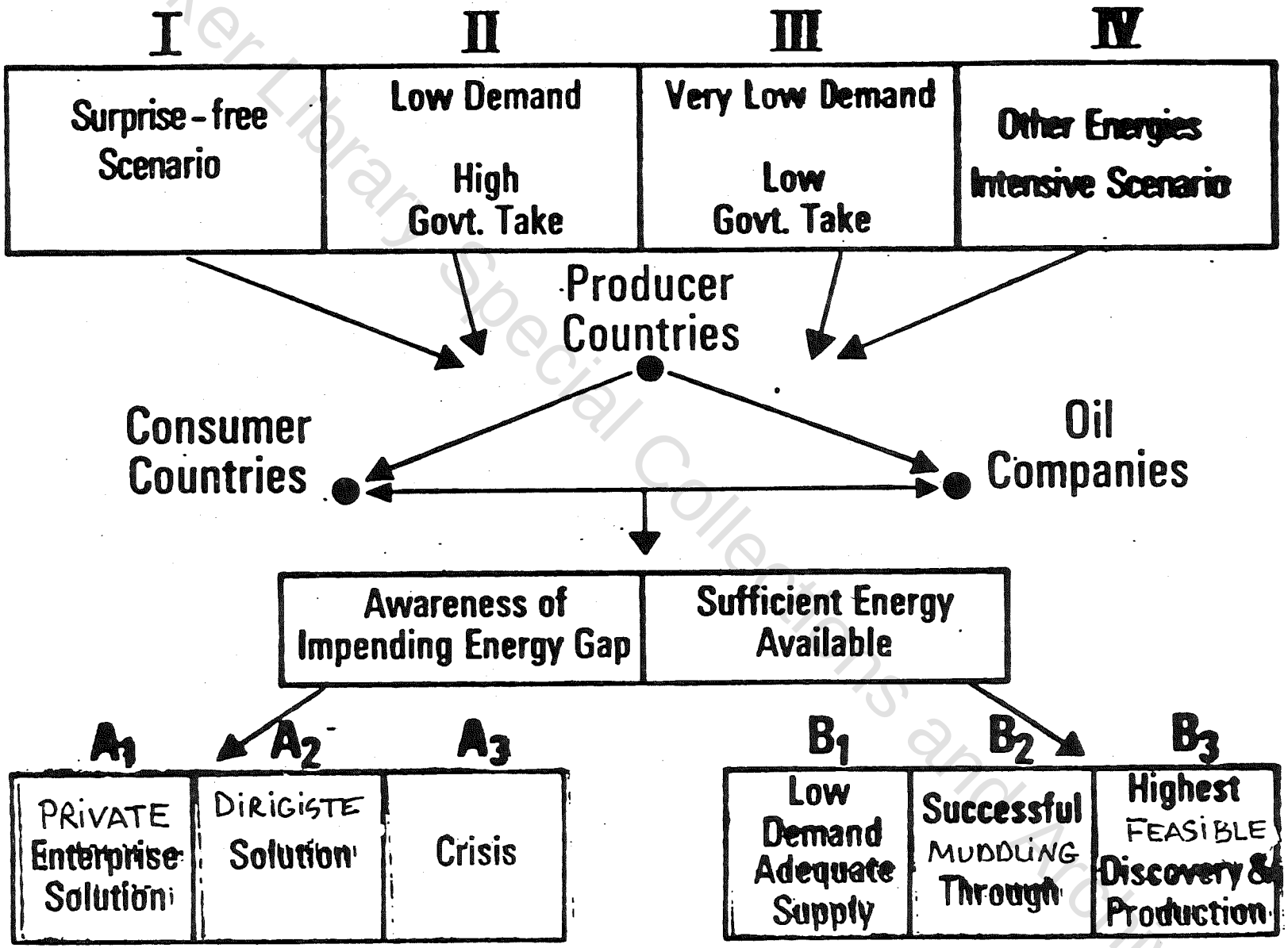
In addition to the Triangle Study, completed in 1972, we made a number of other analyses. We looked at different rates of oil demand growth by class of market; at implications of higher oil prices on balance

of payments and inflation rates; at the reactions of oil-consuming governments; at changing market conditions as it passed from buyer to seller; at changing consumer behavior; at inter-fuel competition in various sectors of the market; and at the changing "cut" of the barrel (the proportion of gasoline versus heavy fuels, heating oils, and jet fuels). We examined variable capacity and new construction in refinery, marine, and market facilities; rates of price escalation in new investments; the profitability of different segments of the business. We had many building blocks. Taking these along, seven of us retired to a former monastery in the southern French Alps (to the amusement of many at Shell) to spend a week away from the office atmosphere with a specific purpose: to design a set of planning scenarios as a proper framework for decision making.

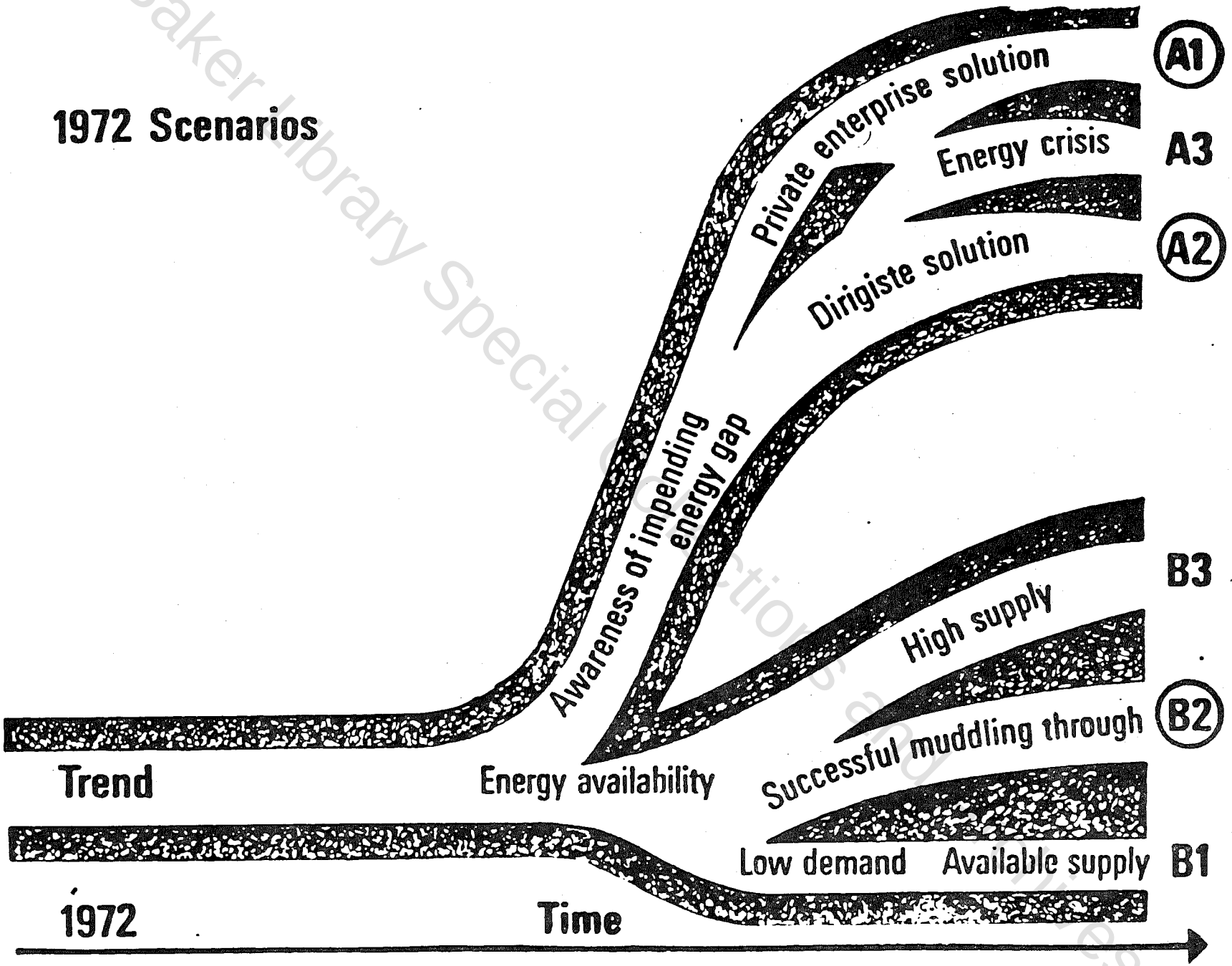
The A and B Scenarios

From our retreat we returned with a brand-new set of scenarios, divided into two main families, A and B (these appear graphically in Exhibits 11a and 11b). The A family included a major discontinuity seen to be a likely result of present trends, namely the impending scarcity of oil and an ensuing sharp increase in its price. To a lesser degree, the price of other energies was also expected to increase. We examined three ways in which circumstances might develop: scenario A1 was a private-enterprise solution to the emerging energy shortage; A2 was predominantly dirigiste, that is, based on government intervention; A3 presupposed a full-scale energy crisis resulting from the failure of the above solutions to be effective in time. This family of scenarios emerged with great likelihood from our analysis, but it was at sharp variance with the implicit "world views" prevailing at Shell. We realized we had a formidable communication task.

1971 Scenarios



1972 Scenarios



To deal with this we developed two exploratory scenarios, B1 and B3, to serve as challengers to the assumption underlying our A-family. These challenge scenarios resembled our earlier exploratory scenarios. B1 was a protracted low-growth scenario. While such a scenario had possessed some reasonable plausibility in the environment of 1971, as indicated above, by the beginning of 1972, when we worked on these scenarios, we could already see the signs of a coming economic boom. We did not know, of course, the extent of this period of above-average growth; we did not know that growth in 1973 would be the most spectacular since the Korean War. But already we could see that our low-growth scenario, B1, was extremely unlikely: it would require an immediate and sharp drop in the growth rate of the world economy, which we had no reason to anticipate. Moreover, the cultural trends of the late 1960s in industrial countries were dying out. Governments and the public perceived the rising unemployment as a problem and were consciously seeking growth. So, the B1 scenario, requiring very low growth for a long period (about 10 years), had a very low credibility. It performed its function most effectively, however, by showing that its assumptions and implications were not at all likely.

B3 was a more important alternative, postulating a very high supply of oil. We called it the "three miracle" scenario, because it required three extremely unlikely situations simultaneously. First, it required an exploration and production miracle. Our original surprise-free scenario had predicted a certain level of demand for oil. To meet that demand, rapid development of Middle Eastern reserves and extensive new discoveries were necessary. Our E&P (exploration and production) staff believed that there was a 30 percent likelihood of finding the necessary reserves in each of the oil provinces individually, but that there was only

a very small percent chance of finding the necessary reserves in all the areas. Meeting the forecasted 1985 demand would require 24M b/d from Saudi Arabia, but also 13M b/d from Africa, 6M b/d from Alaska and Canada. Many new discoveries would be needed for these figures to become reality.

The second miracle demanded by the B3 scenario was a socio-political one: all major producing countries would have to be happy to deplete their resources at the will of the consumer. Countries with low absorptive capacities, under this scenario, would have to produce huge amounts of oil and put their money in the bank, exposed to erosion by inflation, rather than keep their oil in the ground for future generations. This scenario projected onto the oil-producing countries the values of consuming countries--a kind of Western cultural imperialism that was extremely unconvincing once examined rationally.

The final miracle necessitated by B3 started with the recognition that there would be little, if any, spare capacity over projected demand under the high-supply scenario. Previously when minor crises developed in the Middle East, there had always been oil producers to meet sudden, short-term additional needs. For instance, in 1956 during the Suez crisis, Texas and Louisiana helped out with their spare capacity. Similarly, during the June 1967 Middle East conflict, Iran called on its spare capacity to meet consumers' needs. Under Scenario B3 there would be no spare production capacity. The miracle, then, was that there would be no need for it--no wars in the region, no acts of God, no cyclical peaks of demand higher than anticipated. Again, nothing short of miraculous.

This exploratory scenario also performed its function very well by demonstrating that the high-supply assumption was extremely unlikely.

Its essential role was educational: to reinforce the validity of the assumptions underlying the A-family scenarios.

The A-Family

The A-family scenarios assumed moderate growth through 1976, with subsequent growth threatened by a possible scarcity of energy. At this point, most oil-producing countries would be reaching the technical limit of their capacities, while those still having capacity would be reluctant to increase output due to their inability to absorb any additional revenues. The A scenarios held that oil prices would rise substantially at the renegotiation of the Teheran price agreement at the end of 1975. As consuming countries were confronted with the possibility of physical shortages in energy supplies and with greatly increased oil-import bills, there would be shock waves. The essential point in this family of scenarios was discontinuity: Shell would have to prepare for a sudden change in the behavior of producing and consuming countries that would result from their awareness of an impending imbalance between demand and supply of oil.

The discontinuity might arise from a situation of tension, created by the producing countries' imposing a limit on the amount of oil they produced. The discontinuity could also occur if these nations announced a gradual decrease in the rate of production growth, or if they gave advance notice of such a policy. In any case, the awareness of an impending energy gap constituted only the first stage of the process. The most important consideration was the timing and direction of the active response to such awareness. The three scenarios of the A-family analyzed three different responses.

Scenario A1. Scenario A1 was the private-enterprise solution, probably the most efficient solution to the problem of scarcity. Such a solution would not be equally acceptable or successful in all countries, and in some countries would probably involve considerable government intervention as well. The consequences of perceived energy shortage under this scenario were described by Shell in 1972 as follows:

> Because of the positive reaction of oil companies and consumer governments to the problems that arise, particularly due to the high price of oil (e.g., balance of payments, inflation, etc.), gradual adjustment is achieved with only a fairly modest impact on the rate of economic growth, and, after the initial setback, particularly in Europe, there is considerable recovery. Because of its lesser dependence on imports and greater indigenous resources, North America is less affected than the other regions. Japan, after the initial shock, is expected to make a strong recovery after 1980 and in many ways welcomes the increased prices of crude oil as this offsets the need for further revaluation of the yen which would adversely affect its export potential. Despite measures taken by the oil producing countries to help the developing countries by providing them with more reasonably priced oil, there is some fall in their economic growth rates. The prospect of oil scarcity leads to government encouragement for private activity in the development of both oil and coal, particularly the development of new technology, and particularly in the U.S., and this, combined with rapidly rising prices, contributes to an early bull market in oil company shares and the ability of oil companies to raise new capital.

Scenario A2. The second member of the A-family postulated a dirigiste solution, using government intervention to develop additional sources of energy, to allocate currently available supplies, and to enforce conservation. The scenario package described the anticipated effects of such a solution as follows:

> Balance of payments problems, inflation and declining foreign reserves, partly resulting from high government take, in addition to the physical scarcity of energy supplies, have a pronounced effect on the economic environment by the late 1970s. Governments, however, step in to deal with the situation and are particularly successful in North America and Japan, where the groundwork has already been prepared. In

> Western Europe deflationary measures have to be taken partly as a result of the serious trade imbalance which follows from rising oil prices and various protectionist moves as governments fail to stimulate indigenous energy production in time or to introduce policies quickly enough to cope with the associated economic problems. After 1980, however, Western Europe develops a coordinated response to the situation and the rate of economic growth picks up again. The developing countries suffer a severe setback in the late 1970s with trade with Western Europe badly affected and difficult economic conditions elsewhere.

Scenario A3. The final A-family scenario foresaw a crisis arising from the late realization of the energy shortage and a delayed response by both private and public institutions in dealing with it. The consequences according to this scenario, by far the most serious of the three, were as follows:

> By the late 1970s economic growth rates in all consuming regions are severely hit, with the U.S. only slightly more insulated than the rest. All the economic implications of the gap and high-tax situation come to the fore with the balance of payments impacts and high inflation rates contributing to instability of international trade payments. Oil prices spiral under market forces and the problems for producing governments which find it difficult to absorb funds are made even worse. Energy consumption has to be severely constrained, in many cases by rationing. There is widespread nationalization and tight government control of oil companies. This is the worst scenario for the private oil companies, and if this situation occurs, the international oil industry will never be the same again as it becomes severely regulated by both producer and consumer governments on a long-term basis.

Scenario B2. With the advantage of hindsight, the critical assumptions of the A secnarios look rather obvious; at the time they were viewed as quite the reverse. We believed in them and put them forward very strongly as the most likely direction of events, but they did represent a major revolution in thinking for an oil company. Another scenario without extreme discontinuities was needed to balance the A-family. Therefore, we introduced B2, a totally artificial construct, which was a genuine challenge to the A-family.

B2 was a middle-of-the-road scenario indicating that despite all the problems, a muddling-through approach would be more or less successful. A widespread sentiment, particularly among Anglo-Saxon managers, is well expressed by William Ogburm: "There is much stability in society. . . social trends seldom change their directions quickly and sharply. . . revolutions are rare and evolution is the rule." We couldn't really justify this scenario, but we knew that the worst outcome is not always the one that develops, and we imagined a situation in which the most positive outcomes were the norm. Oil-producing countries would take a live-and-let-live approach in order to obtain military and other concessions. Consuming countries, with great foresight, would take immediate steps to curb the rapid growth of oil consumption by encouraging energy saving. The great danger was that this scenario coincided with the best estimates for oil demand by the major operating companies. It was thus a surprise-free environment as long as we did not probe too deeply into current forces. As soon as we did any serious digging into what underlay this scenario, it became much less convincing.

Making Scenarios Convincing

We fully quantified our set of scenarios in terms of volume, prices and their impact on individual oil-producing countries, on oil-consuming countries, on inter-fuel competition in different markets. When we presented this set of scenarios to our managing directors, we received a great deal of attention, in contrast to our previous presentation. The discussion which followed lasted over two hours and resulted in two decisions: (1) to implement scenario planning in headquarters and large operating companies; (2) to warn oil-consuming countries' governments. This was done orally starting from October 1972,

and in May 1973, Shell distributed a brochure entitled "The Impact on the World Economy of the Market for Oil," based on a single scenario which stressed discontinuity. The brochure traced the effects of this discontinuity on oil-consuming countries' balance of payments, rates of inflation, resource allocation and so on.

For internal use, Shell asked its major downstream operating companies to evaluate their current strategies against two A-type scenarios, using the B scenario as a sensitivity check. Smaller companies were requested to base their planning on a trend extrapolation leading to the B2 ("Muddling Through") scenario: a greater shift was thought to be too great a shock for them.

The scenarios were presented to a meeting of all the coordinators (the second echelon in Shell's organization). For most, it was their first encounter with the scenario approach. Compared to the traditional UPM meetings dealing with forecasts and premises in an overload of figures, scenarios, focusing not on outcomes but on understanding the forces at work behind the possible outcomes--not on figures but on insight-- benefited from the comparison with UPM. It was an unusually long meeting by Shell standards and the audience was clearly impressed and appreciative. At the end of the meeting as in other follow-up meetings, it seemed that a large majority of the audience had been convinced.

In reality, the following months would show that a fraction--about a third of Shell critical decision centers--were really acting on the insights gained through the scenarios and actively preparing themselves for the A family of outcomes. Although the scenario package had created an intellectual interest, its essential failure to be translated into a change in behavior in much of the Shell organization came as a shock and broke

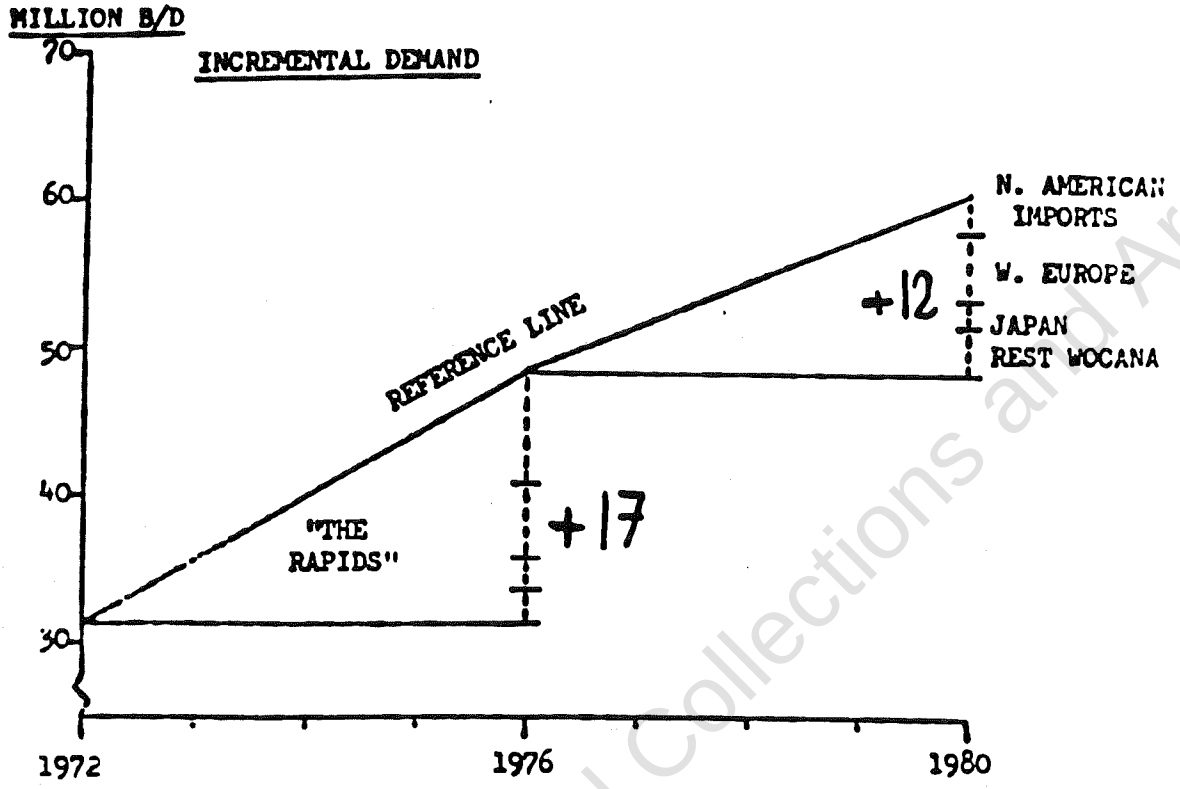
through a psychological barrier in our understanding of how to "design" scenarios geared for decision making. We were forced to examine painful reality: the very low existential effectiveness of most studies dealing with the future business environment, if we define existential effectiveness by "single-mindedness," or as the Japanese strikingly formulate it, "Where there is no break, not even the thickness of a hair, between a man's vision and his action." A vacuum cleaner, for example, has an effectiveness of 25 to 30 percent; the rest is dispelled in heat and noise. Future studies, particularly when they point to discontinuity, have an effectiveness way below that of a vacuum cleaner. If one's role is a corporate look-out, and one clearly sees a discontinuity on the horizon, one tries to understand what makes the difference between a more and a less effective study.

One of the differences involves the basic psychology of decision making. Every decision maker has a mental model of the world in which he or she acts. The model is based on past experiences and on the information which have been internalized. When someone has a decision to make, he confronts alternative ways of behaving with his mental model. When someone makes a good decision, others say he has good judgment. In fact, he has largely a mental map that is a good match for the real world. We call this mental model or map of the decision maker a "microcosm,"--the small model in the head--as opposed to the "macrocosm," which is the large real world out there.

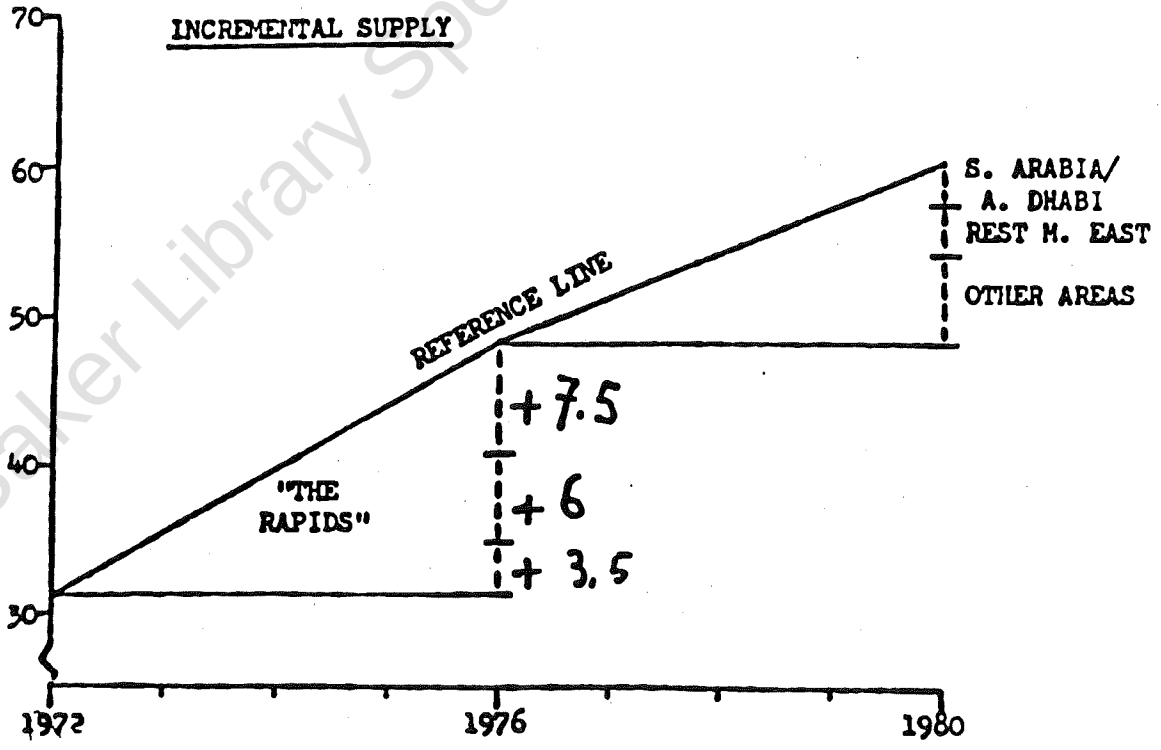
There is also a corporate world view or microcosm. During a sabbatical year in Japan, I became aware that, for example, Nippon Steel was not "seeing" the steel market the same ways as Usinor, and this led to differences in behavior and priorities. The type of perception a company

WOCANA INCREMENTAL SUPPLY DEMAND, 1972-1980

GRAPH 3(A)



GRAPH 3(B)



has of its business environment is as important as its infrastructure of investment.

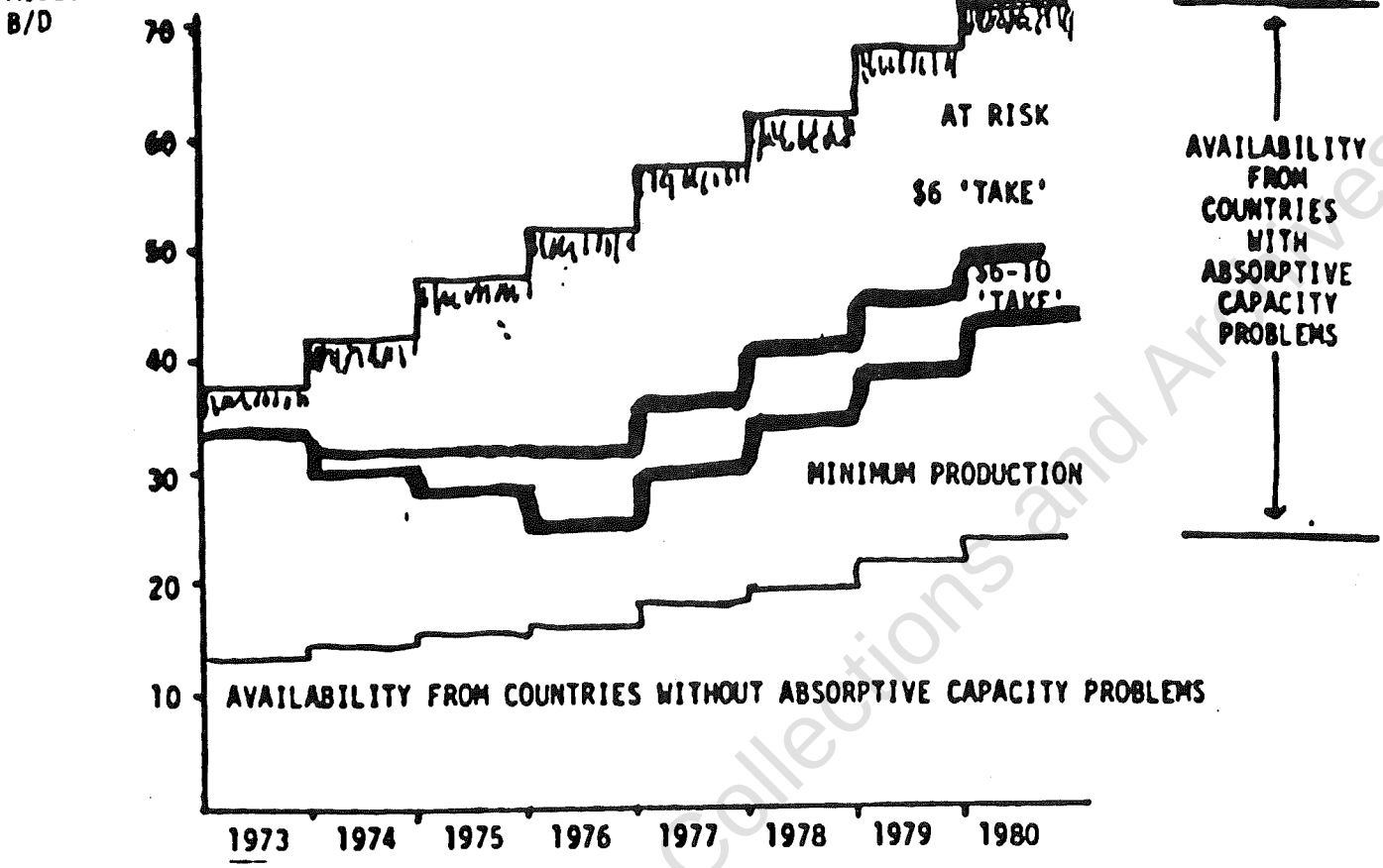
The point is: unless the microcosm is changed, no change in behavior will occur.

From that point on, we no longer saw our task as producing a well-documented view of the future business environment five or ten years ahead. Our real target was to have an impact on the microcosms of our decision makers. This was different and much, much more than producing a relevant scenario package; unless we affected the mental image, the picture of reality of critical decision makers, our scenarios would be like water on a stone. Whereas our aim had been to produce scenarios we would not be ashamed of when later confronted with reality, now we began to design scenarios which would lead our decision makers to take action they would not be ashamed of later. This was a fundamental switch, with widespread implications for scenario design.

THE 1973 SCENARIOS

When we came to do our planning work in late 1972, our monitoring of current events and our new analyses all pointed once more to the major discontinuity. Prices would rise rapidly, and oil production would be constrained, not because of a physical lack of oil, but for political reasons--taking advantage of a very tight supply-demand relationship. We now saw discontinuity as totally predetermined; <u>it</u> had become the surprise-free scenario. The only remaining uncertainties were timing and magnitude. We could not foretell precisely <u>when</u> this discontinuity would occur, and we could not determine the <u>size</u> of the price change or which of the ways by which production would be limited.

WOCANA CRUDE OIL AVAILABILITY



SUPPLY AND DEMAND ON WOCANA OIL RESOURCES

CHART 9

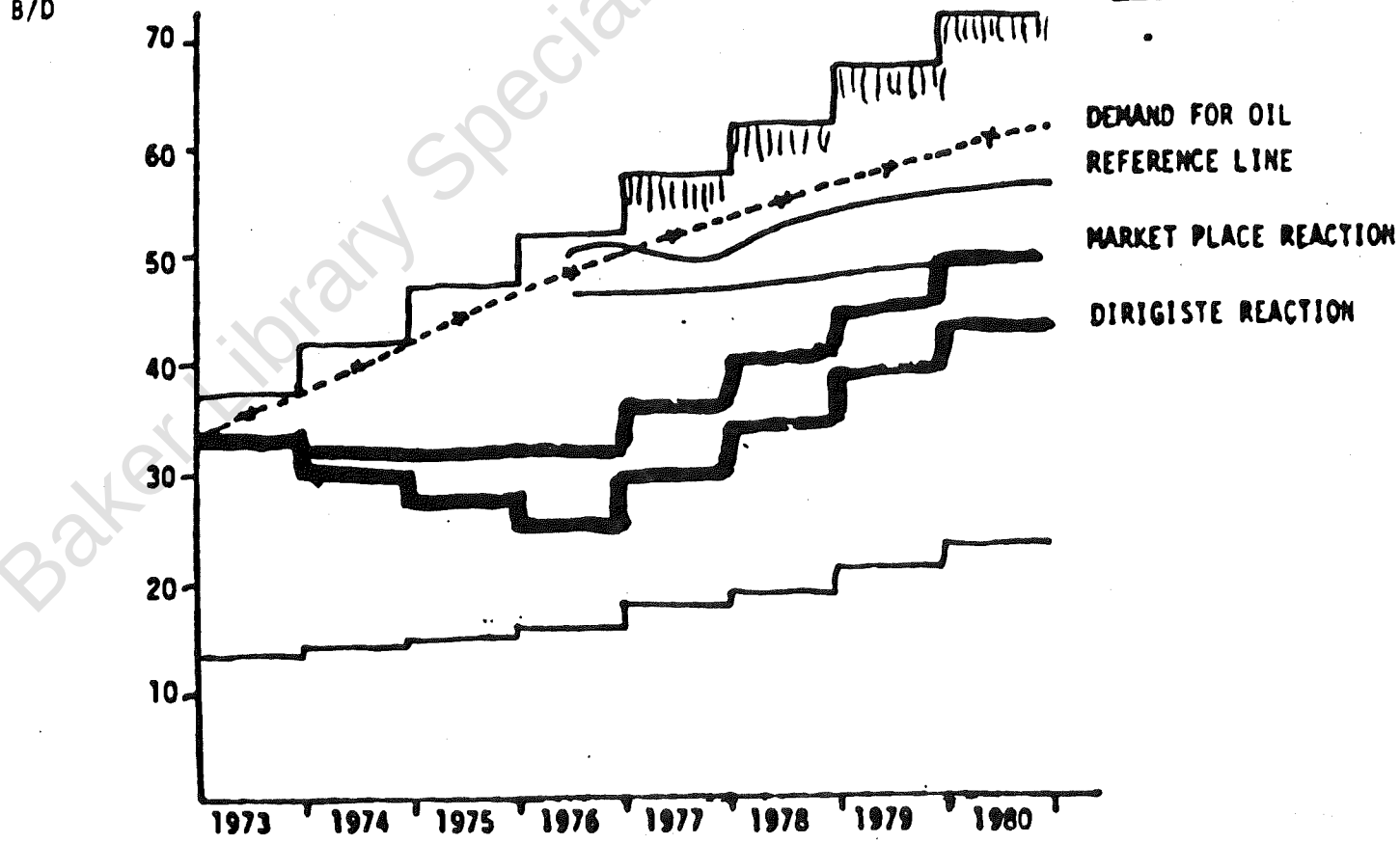


Exhibit 12 displays the anticipated growth in demand for WOCANA* oil, according to our 1971 original surprise-free scenario, in the "reference line" as marked on the charts. Demand was forecasted to grow, under the business-as-usual scenario, from 31.5M b/d in 1972, to about 60M b/d in 1980. For purposes of analysis, we divided this period in half, with 1976 as the line of demarcation. Demand between 1972 and 1976 was expected to grow by 17M b/d in that period of four years, the same number of barrels a day of growth as that experienced between 1964 and 1972. From 1976 to 1980 we believed the rate of growth in demand for WOCANA oil would diminish because oil would be available from Alaska and the North Sea by that time; 1976 was critical as well because the renegotiation of the Teheran Agreement would have occurred during 1975, and was sure to alter the size of producer-nation take.

The lower chart in Exhibit 12 shows sources of the supply required to meet the demand represented by the reference line. Between 1972 and 1976, most of the incremental supply would have to come from the Middle East, while from 1976-1980, nearly half would be supplied by other areas.

A more detailed treatment of the supply-demand relationship appears in Exhibit 13, in the bottom chart. Here the dotted line shows demand under the surprise-free scenario. Above it the maximum technically feasible production is indicated by rising steps (this also appears as well on the chart at the top of the exhibit); the shaded area just below each step represents the approximately 5 percent operating margin routinely

---

*WOCANA: World Outside Communist Areas and North America.

deducted by oil companies because the technical maximum is rarely achieved in a sustained way. The chart reveals how close the available supply and the anticipated demand would be during the years 1972-1976. It must be recalled that after the recession of 1971, an economic recovery had started in mid-1972 and was to become one of the largest on record: in 1973, the U.S. economy grew at the rate of 7 percent; Western Europe's at 6 percent; Japan's at 12 percent.

The table below shows how close supply and forecasted demand would be in the years 1973, 1974, 1975, and 1976. All the supply figures were fully predetermined because of the long lead time required to bring oil reserves into production.

	1973	1974	1975	1976
	(million barrels per day)			
Technically feasible production	34.7	41.2	46.3	50.8
Less 5% operating margin	34.9	39.1	44.0	48.3
Reference demand	34.5	39.0	43.6	47.4
Adjusted for a likely cyclical downturn	--	--	42.4	45.5

The final entry in the table above reflected our belief that the boom would gradually give way to an economic downturn. Even these figures, however, were extremely close the maximum available supply of oil.

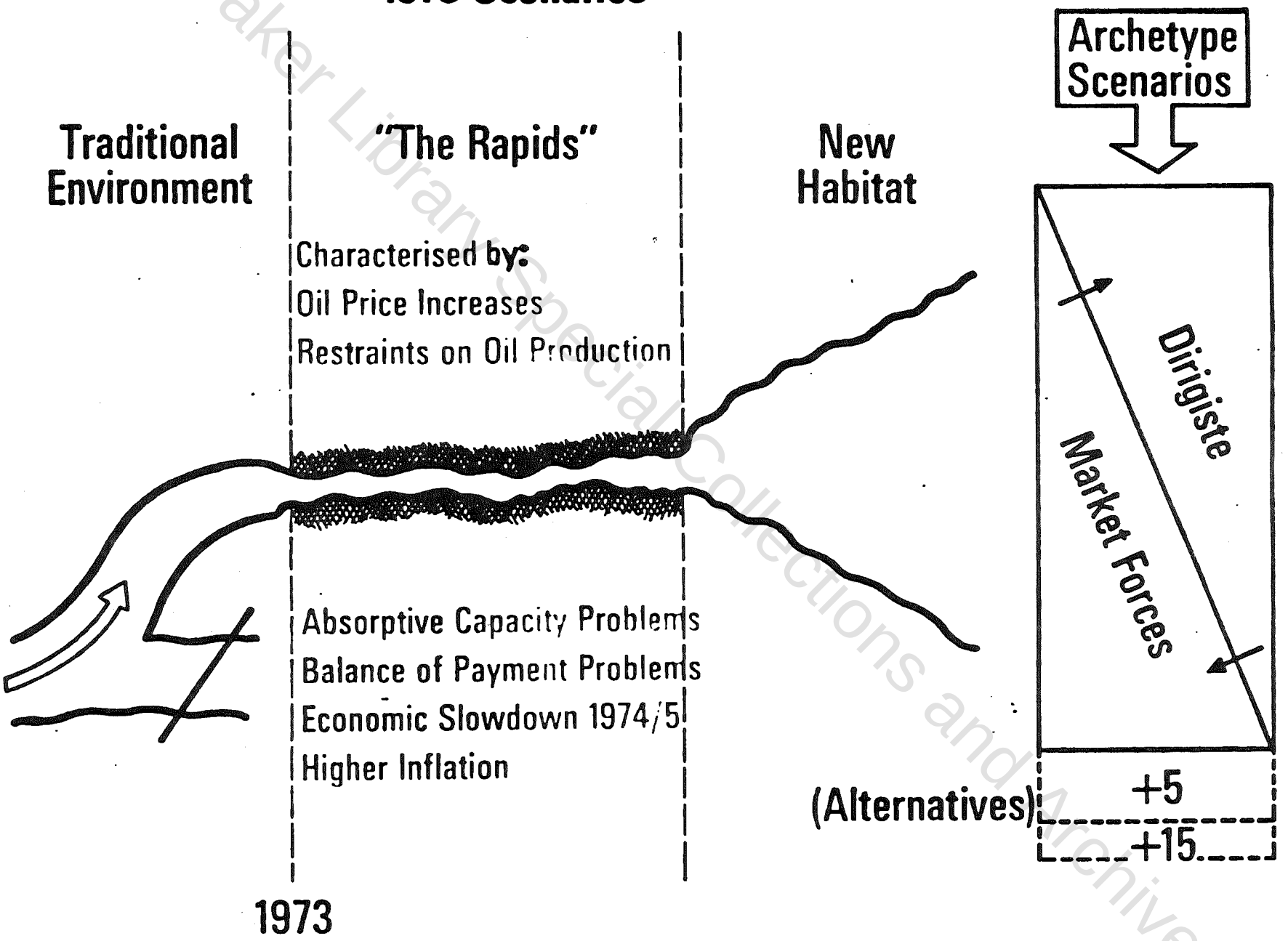
The upper chart in Exhibit 13 shows some of the implications of this situation. We divided supply into three categories. The bottom portion of the chart, shown with close cross-hatching, represents the portion of oil supply that would come from nations whose financial requirements were greater than the revenues their oil sales would provide.

These countries--Nigeria, Venezuela, Indonesia--had no absorptive capacity problems; on the contrary, they needed all the oil revenues they could get and would want to produce all the oil they could. Above that portion of the chart appears the oil supply which would come from nations with problems absorbing potential oil revenues. The middle (crosshatched) section shows the levels of production required to meet these countries' anticipated financial requirements. The top portion, shaded with slanted lines, indicates the part of the demand for oil which would have to be met with production whose revenues the producing nations did not really need. This supply was at risk: there was no compelling motivation for the producing nations to provide this oil. Already in the 1972-1976 period this component of supply was quite large and growing rapidly.

Another type of risk revealed by our analysis derived from the closeness of projected supply and demand. Production in the Middle East, in our forecast, would have had to nearly double in the years between 1972 and 1978. But new facilities often met with construction delays. We had just seen an example of this in 1972, when a new port facility in Saudi Arabia had been completed eight months behind schedule. Any such delays in field, pipeline, or port facilities would be unusually serious because there was so little margin between expected supply and demand.

Political difficulties affecting supply would produce similar risks, and as part of our analysis we simulated five such situations. We looked at a loss of Libyan supplies for a year, since Colonel Quaddafi had already begun to show his militance and seemed to have all the money he needed. We considered the possibility that the Arab Gulf states would freeze their production at 1974 levels for a year; that Saudi Arabia and Abu Dhabi would restrict the growth of their production to 10 percent a

1973 Scenarios



year; that Saudi Arabia and Abu Dhabi would freeze their production at 10M b/d; and finally that there would be a total loss of OPEC supplies for three months in 1974, as might be the case in an Arab-Israeli conflict. Under any of these simulations, the market would abruptly switch from a buyers' to a sellers' market.

Our new scenario, then, bore the same message as the previous year's: a major discontinuity was clearly imminent. There were, however, two basic differences between our 1972 and our 1973 scenarios. First, we had a new sense of urgency. As compared to our 1971 scenarios, the time available for an oil company to prepare for and respond to a major discontinuity had been radically reduced. Second, we had learned from our experience of the previous year that we had to have an impact on the view of reality--the microcosm--of our decision makers. No longer was our object merely to produce a scenario booklet summarizing views; now we wanted to reframe the outlook of our managers in a very profound, existential way. Herein lies the unique effectiveness of the mode of action of scenarios in a large company like Shell: a strategy is the product of a world view; if the world view is changed, widespread decentralized strategic decisions follow without leading to anarchy, more effectively than any centralized planning instructions could bring about.

The results of this reframing effort appear in Exhibit 14. Again, we presented the future as a river. Now, however, we showed only one route into the future; the alternate branch (the "Bs" of the 1972 scenarios) has been cut off. Our surprise-free predetermined evolution now led us into turbulent white water which we called "The Rapids," characterized by oil price increases, restraints on oil production, absorptive capacity problems in producer countries, balance of payments

problems, and economic slowdown in consumer countries, and higher inflation. The metaphor of the rapids was deliberate. In the farthest part of the Shell world--from Shell Finland to Shell Argentina--management would know what "the rapids" meant. From the calm water of the traditional environment, we were to be plunged into a completely new habitat.

We learn from studying evolution how an animal suited to one environment must adapt, must become a new animal, to survive when the environment undergoes a severe change. That was the sort of change we foresaw, and we believed that Shell would have to become a new animal to function in the new world. Business-as-usual decisions would no longer suffice, and this element in our message was really the most important.

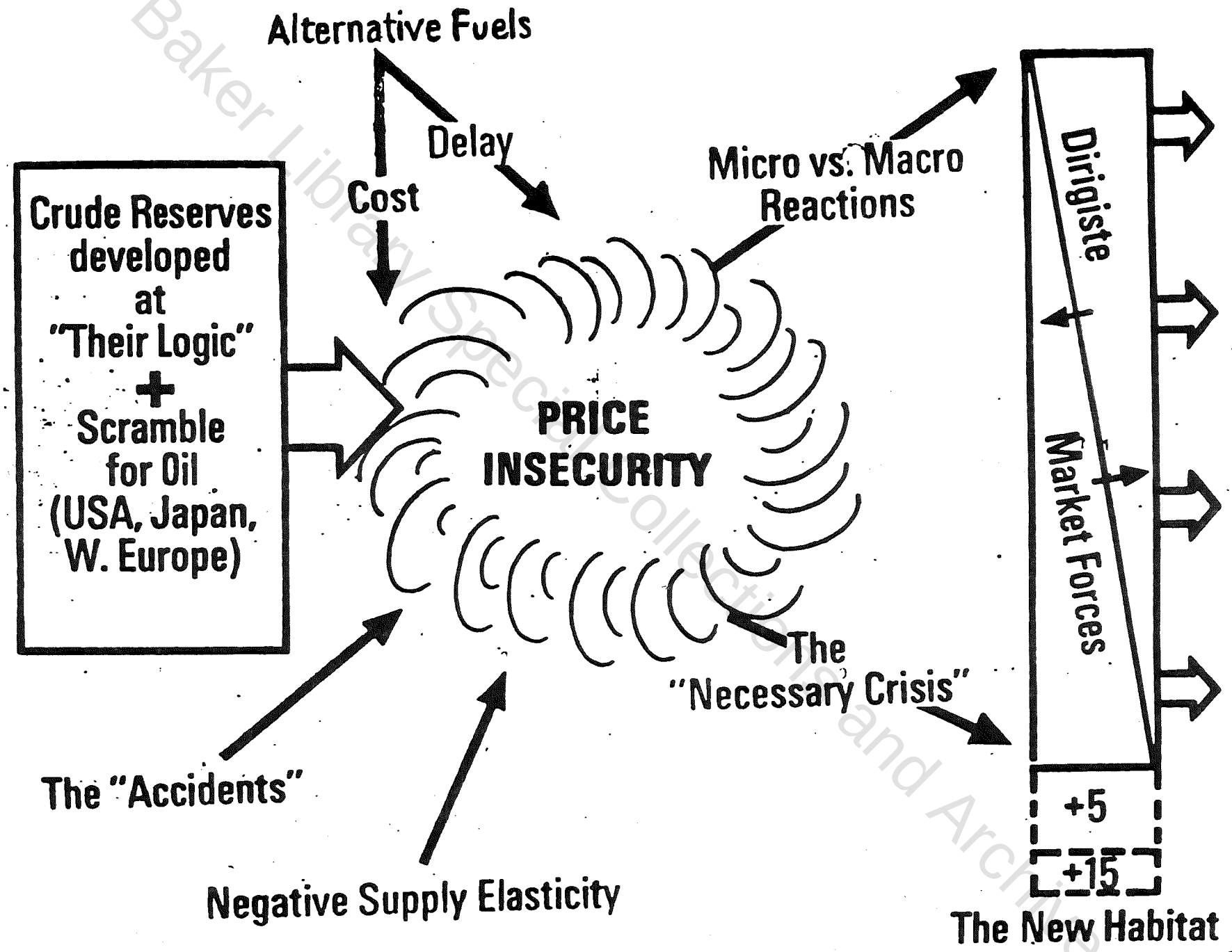
The Market-Force and Dirigiste Archetypes

As planners working for the central management of an international company, we faced a special problem. The message of our scenarios had to be useful for our managing directors, but it also had to be of use to our regional companies, for Shell Canada, Deutsche-Shell, Sekiyu Shell (Japan). Yet the dramatic changes we anticipated would affect every nation differently, and hence would not be the same for all our operating companies. What meaningful things could we say from the center that would also be meaningful for Shell Oil, for Shell Australia, and for Shell-Francaise? To solve this problem we borrowed the concept of archetype from human character analysis. Just as we are accustomed to viewing individuals as composites of archetypes, for example, introvert and extrovert, even though no one person is totally an extrovert or totally an introvert, so we sought archetypes which would enable us to examine national responses to the coming upheavals.

In our view, the world would be able to cope with this major discontinuity by either a market-force approach or by a government-intervention (dirigiste) approach. In their pure forms, these responses became our archetypes, and we explored each of them fully. We did not imagine that any country would follow either archetype absolutely, but we believed, for example, that West Germany's response would be heavily market-oriented, while that of its neighbor France would tend more toward the dirigiste archetype. The actions anticipated under each archetypal response in terms of price increases, taxes, alternative fuels development, regulations, were analyzed by class of market.

In addition to providing the archetypes, we created two "Phantom Scenarios"--alternatives to our main scenarios, but ones we considered illusions. In one of our phantom scenarios, we assumed that five years would pass before the discontinuity, and in the other, that it would be fifteen years. We chose five years and fifteen years because it takes, on the average, five years before a typical new oil facility becomes operational. The fifteen year figure was chosen because that period, in general, is needed between the decision to invest and the full amortization of the facility. In our phantom scenarios, then, we considered what the situation would be if business-as-usual lasted for five more years, and for fifteen more years, but Shell had prepared instead for the discontinuity scenario. Exhibit 15, another chart displaying our view of the future, shows these scenarios at the bottom left.

I have already referred to the remarkable economic development that was occurring from late 1972. The OECD economies were growing very rapidly, and international trade was expanding at about 30 percent a year, in nominal dollars. We were entering the biggest boom we had experienced



since the end of the Korean War. Oil consumption growth exceeded that of our reference line. In this environment it was particularly difficult to say to an oil company having a love affair with expansion that this was the time to stop, to cease building refineries, service stations, and tankers. Because this message was so hard to convey, we developed our phantom alternatives. They enabled us to measure the "regret" we would experience if we adopted our main scenario, but the events that we foresaw did not occur for several years.

Furthermore, upon examination, the phantom scenarios appeared so unlikely that they performed their functions very well. The only situations making business-as-usual possible for a prolonged period demanded either the discovery of huge new reserves of oil--virtually a new Middle East--in areas without absorptive capacity problems, or the dominance of producing regions by the consuming countries through some political or military intervention. Neither situation gained many supporters, and the phantom scenarios thereby acted to reinforce the unpalatable message we were sending.

Exhibit 15 depicts the same effort to reframe the view of the oil market as that in Exhibit 14, but in a somewhat different perspective. On the left, in the rectangle, are the predetermined elements--events which were already in the pipeline: the fact that oil reserves would soon be developed according to oil-producing countries' logic and the fact that a scramble for oil would develop in this new sellers' market. Some singularities in the business environment are also displayed in this exhibit. "Alternative Fuels" (upper center) could be developed only very slowly; none could be available before the 1980s, even under a war-style crash development program. The cost, moreover, needed precise analysis.

We considered the cost of alternative energy in three thresholds. First, other fuels might replace oil as "underboiler" fuel, that is, for power generation and for steam generation in large industrial settings. For these uses, coal and nuclear energy were the cheapest sources. It was clear that oil-producing nations would not be impressed by alternatives that replaced their precious hydrocarbons in underboiler applications. On the contrary, they believed their oil was far too valuable for such uses and would welcome coal and nuclear power to displace oil in those low-value markets. The next threshold, oils used for heating, was the one that really counted. For such uses, to burn coal as such was not good enough: it was necessary to gasify coal at great expense or to transform it into electricity, with enormous thermodynamic losses when used for heating purposes. The price for this threshold, then, was very high, and we did not expect to exceed it in the near future. The third threshold, oil used in transport, was even higher than the second and was thus irrelevant for our analysis.

Another key element shown in Exhibit 15 was oil's negative supply elasticity. Unlike most commodities, the supply of oil would not increase when its price rose at least for a number of years. On the contrary, for major exporting countries, the higher the price of oil would go, the lower the volume of oil it would be in their national interest to produce, and this would more than compensate the eventual increase of production by smaller exporters.

The "Accidents" referred to on the bottom left of the exhibit constituted another major and inevitable factor. In our terminology, accidents included internal and external political incidents as well as physical ones. No one familiar with the oil world could discount the

likelihood of such events. In the same way, anyone living in the Philippines, where typhoons are a frequent occurrence, knows with certainty that the strength of his roof will be tested by strong winds. Even though the weather in the Philippines is usually balmy, the only uncertainty is when one's roof will be tested. So it was with accidents in the world of oil now there was no spare capacity in the system.

In the center of Exhibit 15 is the major discontinuity, price increase insecurity in supply, and in the rectangle on the right the range of possible effects, going from dirigiste dominated response to a market-force dominated response, and including all the intermediate possibilities. At the bottom appear the two phantom scenarios.

Implications

The four arrows on the right of Exhibit 15 represent implications common to all scenarios. The first stands for "the nearly unthinkable" for an oil company. The oil world is divided into two groups, groups with entirely different perspectives who rarely communicate directly with each other. On the one hand are the upstream personnel, involved in exploration and production of oil. On the other are downstream people, who deal with transportation, refining, and distribution of oil. While these are two different worlds, the implication of our scenarios was equally unthinkable in both of them. To the upstream world we said, "Be careful; you are about to lose the major part of your mining rents." This meant that the largest profit element in the upstream world would be lost--a revolutionary message for an oil company. It meant that a new relationship had to be developed between the oil company and the producing nation.

To the downstream world we said, "Be careful; you are about to become a low-growth industry." Again this was revolutionary, because oil

in the past had always grown more rapidly than GNP. All our management culture was based on growth, on management reflexes: investment--and overinvestment--were not really dramatic; one or two years of normal market growth would correct any overly adventurous moves. We now foresaw 1985 consumption in industrialized countries at the same level as that for 1975. This meant no new refineries, no additional service stations. New management reflexes had to be developed to function in a low-growth world.

Our third major implication involved decentralization. No longer, we believed, could we have a single worldwide strategy for all of Shell. It had been Shell's worldwide strategy, for example, to aim for a higher share of conversion in refineries, and it had been quite successful. Now we saw that each nation would be affected so differently by the energy shock that each would have to respond independently. (Shell, which was already very decentralized in many fields, did in fact decentralize its supply system very rapidly, which enabled it to adjust faster to the turbulence it experienced. It is probably the most decentralized of all major oil companies.)

The last implication grew out of the natural tendency of most people to misperceive the variations around a trend for the trend itself. In a boom, the boom growth rate is extrapolated; similarly in a recession--for a mechanical reason: managers receive tremendous quantities of material dealing with an immediate situation and its momentum, and comparatively small amounts of material stressing longer-term perspectives. The resulting disproportionate emphasis on the present tends to distort the outlook, making the current environment, whether a boom or a bust, appear to be the dominant trend rather than a temporary divergence from the trend. Thus, many managers would anticipate continued growth, because we had been

in the middle of a major upturn in the business cycle. On the other hand, we knew that a cyclical decline in economic activity was inevitable. We therefore created three simulations: in each we anticipated both this cyclical downturn and the expected oil discontinuity, but in differing temporal relationships. In our first simulation, the oil shock occurred before the downturn; in the second the two events were simultaneous; and in the third the oil shock followed the downturn. These simulations led Shell to prepare for a far more serious decline in economic activity than we might have been expected.

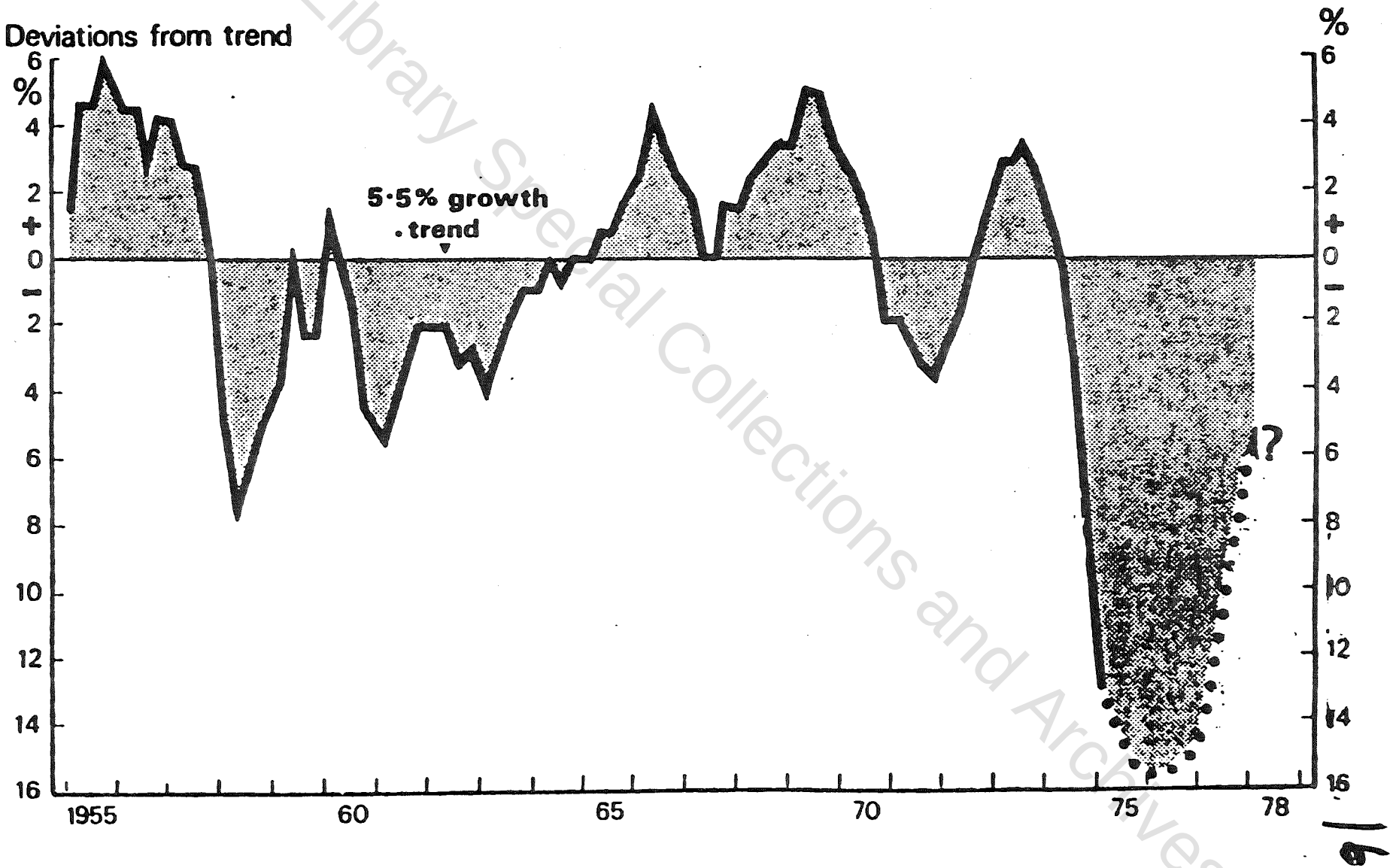
SHORT-TERM SCENARIOS

The previous set of scenarios is rather atypical: the major discontinuity was perceived to be predetermined; the critical uncertainties were perceived only in the reactions to the discontinuity. Therefore, one other example, more typical and also better designed, is presented here to illustrate a different application of scenarios: short-term scenarios.

Traditionally, planning in Shell focused on the medium and long term, describing the environment in which today's investment decisions would come to fruition. In this context, the short term, i.e., the cyclical nature of growth, was taken for granted.

For instance, Exhibit 16 shows the evolution of industrial production in OECD countries: a 5½ percent growth trend was not incompatible with years in which the annual growth rate reached 10 percent or years in which it dropped below 2 percent. In long-term scenarios, the cyclical aspect was, of course, ignored. And the purpose of short-term scenarios was to focus on those short-term cyclical fluctuations around the trends.

OECD Industrial Production



There were several reasons to apply a scenario approach to the short term: cyclical fluctuations and their implications appeared to be much more important for an oil company than they had been in the past. And these fluctuations would affect not only economic growth and oil demand but inflation rates, currency rates, interest rates, and the politically sensitive OPEC supply-demand relationship.

Furthermore, we felt that single line forecasts in turbulent times could be as misleading for the short term as they were for the long term. For example, comparing OECD forecasts with actual GNP growth for six countries reveals the following data (the forecasts were made in December 1974, and the results are of 1975):

	West Germany	France	Italy	U.K.	U.S.	Japan
Forecast:	2½	3	-¼	1 3/4	-2	2
Actual	-3.2	-1.2	-3.7	-1.8	-1.8	2.1

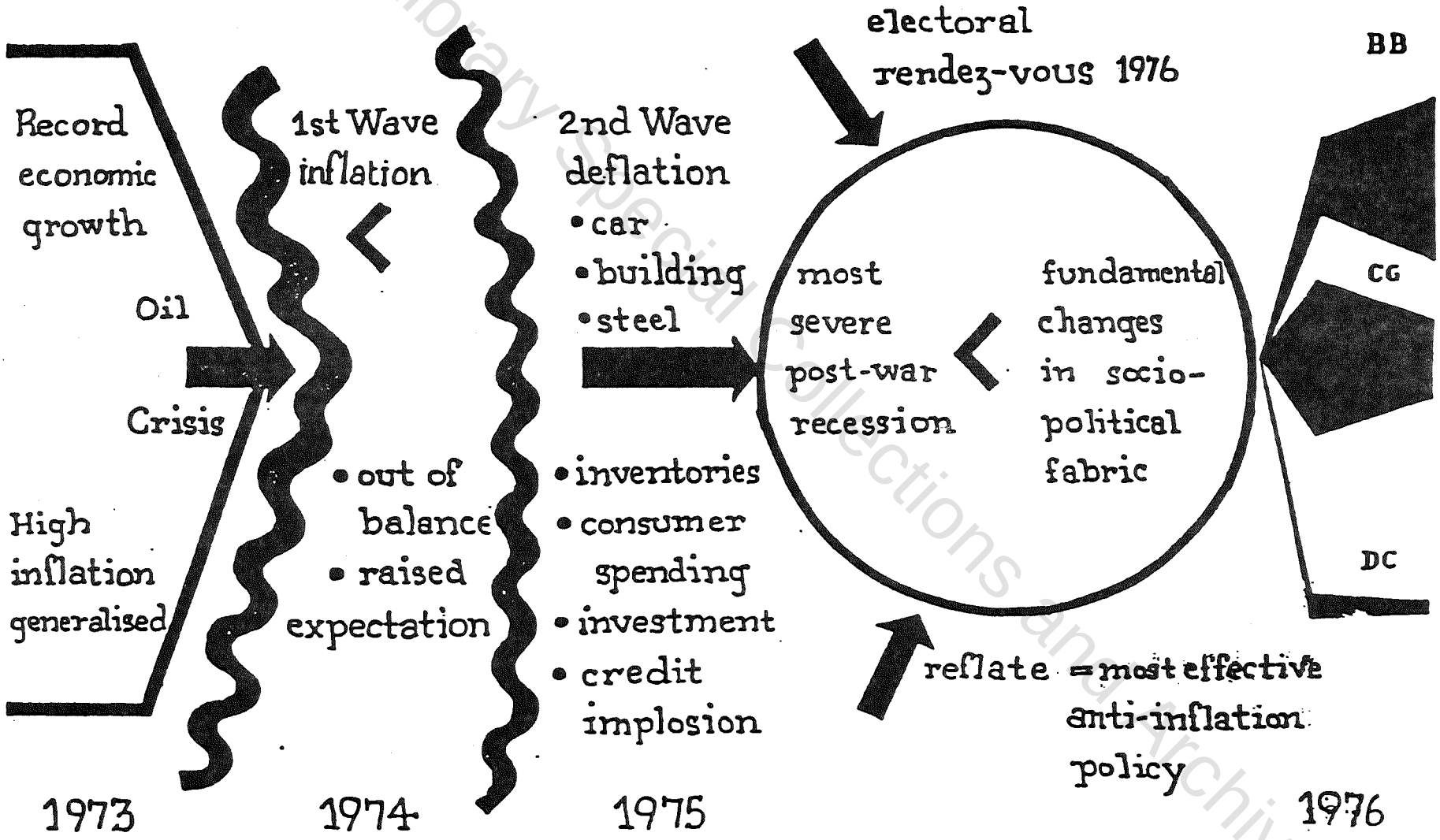
Framing the Microcosm

The subtle process through which the framing of the microcosm succeeds or fails is very similar to transplanting a tree. "Nemawashi" or root-binding is the term used by the Japanese to refer to the traditional techniques of careful preparation of tree roots by pulling them together long before transplanting. Similarly, scenarios cannot be expected to live and develop within a mind-set unless they are propertly rooted.

Exhibit 17 shows the "roots" of the scenarios and Exhibit 18 shows the scenarios themselves. It is immediately apparent that there is much more analysis in the roots chart than in the scenario chart, and this is the rule. Further, the more uncertain and complex a situation is, the

Chart 3

Pre-determined Part of the Present Evolution



more care and time must be devoted to rooting the scenarios. While every situation, and thus every scenario set, is unique, two conditions are always present when the rooting process is effective:

- A careful analysis of the predetermined elements (what is already in the pipeline). To be done properly, this analysis must start upstream in time from the present and ensure that a common interpretation is given to events and data. This might be called the virtue of disciplined observation.

- To reorganize perceptions. A metaphor is helpful, for example, to carry over a cognitive framework from one domain of experience to another; it can bring new perceptions and trigger the mind off into other directions.

There is in the minds of most managers an extraordinary reluctance to entertain, existentially, the concept of alternative future; most managers crave certainty. The scenarios themselves will only be accepted if their common element--the predetermined, the upstream--has entered the mind and unfolds in it. This is what is meant by rooting. Scenarios on their own, i.e., the mere description of alternative courses of events, would be existentially effective just as long as a tree without roots.

We began the scenarios with a macroscopic view of the elements already in the system and cast the major uncertainties within that framework.

The Predetermined Elements of the 1975 Scenarios

Exhibit 17 illustrates some of the past events that would have a major influence on developments in the next two or three years.

1973 - The First Wave: Inflation. Like a large rock dropped in a lake, the oil price increase of 1973 generated a series of waves, the first of which was the impact of quadrupled crude oil prices on the general level of inflation. The dynamic effect turned out to be larger than simple cost-through-the-system arithmetic had indicated (on average 3-4 percent), because world economies in a simultaneous boom were already affected by high inflation prior to the oil shock and were working close to capacity limitations. These economies were caught like boxers off balance: the modest knock had a disproportionately large effect. Further, the immense publicity given to the oil price increase, coming as it did with production cuts and selective embargoes, created a climate in which major economic actors, trade unions, entrepreneurs, and consumers, overanticipated the actual inflationary impact. This and subsequent overreaction added fuel to the fires and led to a substantial increase in the rate of inflation.

1974 - The Second Wave: Deflation. A contraction in demand to well below production capacity was increasingly apparent from mid-1974. The extra cash outflow to OPEC acted similarly to an external excise tax of some $60 billion per annum on consumer demand--or, say, 2 to 3 percent of OECD economies on average. But this was compounded by government anti-inflation policies and pushed demand way below the production potential. The economic dominoes fell one by one:

- The automobile industry, always on the margin of discretionary spending and vulnerable to both the real increase in gasoline prices and the "oil link" in the consumer's mind, suffered an immediate decline, with extensive multiplier effects through the balance of the economy.

- o Building and construction, also a major engine of economic activity, went some six months later as government anti-inflation policy increased the cost of credit and limited its supply.
- o Some nine months after the oil shock, and while most sectors had slipped into recession, the world iron and steel industry was still an island of continuing high activity. Propped up by a backlog of orders (from shipyards, for instance) plus some stock-building, large and welcome orders from the communist world kept it buoyant longer than the oil sector, until eventually the domino effect of automobiles and construction worked its way through.

The recession was deepened by two aspects of behavior by both producers and consumers:

1. Inventories, which were run down drastically between mid-1974 and mid-1975. The imposition of credit controls in conditions of shrinking demand and with the expectation of declining commodity prices was bound to lead to drastic inventory reduction. The impact was underlined by appreciating that running down stocks by only seven days would nullify the effects of a 5 percent underlying growth rate for as long as five months and that the rundown was much larger in many industries.
2. Consumers' expenditure. This main engine of growth had been remarkably stable since the war, with only limited fluctuations around a steady growth trend. The level now

dropped to an unprecedented low for a number of reasons, the most obvious of which related to the decline in earnings and the growth in unemployment. The behavior of those apprehensive of imminent unemployment had possibly been more important. Despite the high level of inflation, there was a strong psychological pressure to save among parts of the working class. Insecurity and anxiety about the future also affected middle-class willingness to maintain consumption patterns, even in countries where fiscal drag and inflation were less serious. When pension nest eggs and other investments for future financial security are perceived to be imperiled, the middle incomers tighten up on spending until they feel safer about what tomorrow will hold.

1975/76 - The Momentum for Change

All this explains why this recession was the most severe since the war:

	Decline in Industrial Production Measured from the Previous Cyclical Peak		
	USA	Europe	Japan
This recession (at 1st quarter 1975)	14%	9%	19%
Previous post-war recessions	7%	2%	2%

The mere depth of the recession was an essential "predetermined" factor for short-term developments. It was viewed in connection with two others:

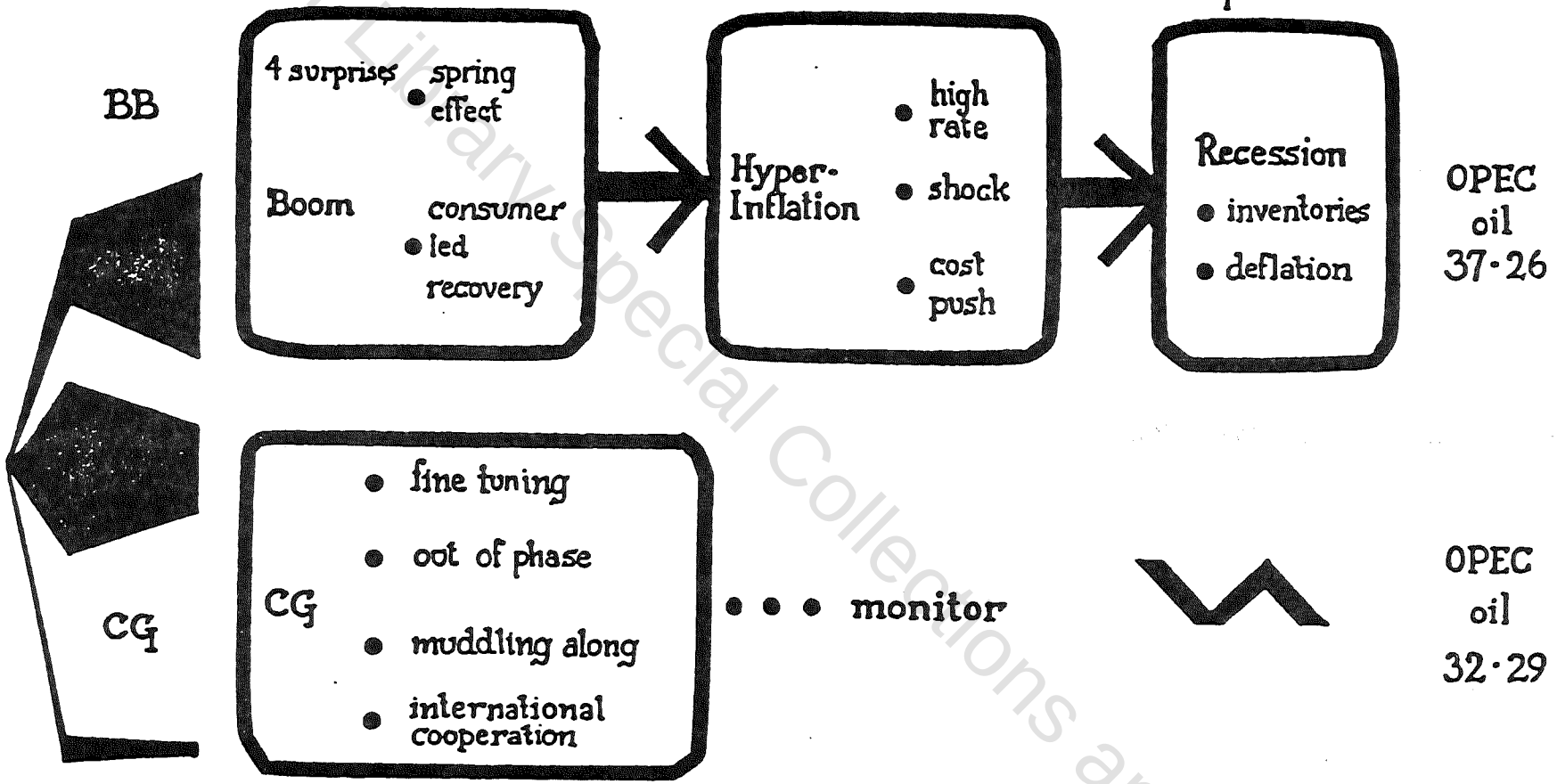
- o The governments of the three major OECD countries would face the electorate in 1976: Japan, Germany, and the U.S. (presidential elections). The prospect of losing power is

a major motivating force and it is courting disaster to face an electorate during a serious recession. The incentive for politicians to go for growth would be overwhelming--another element already in the pipeline.

- o The second factor pointing to the potential for transition was the awareness that much of OECD's current economic hardship was self-inflicted. Most finance ministers had encouraged financial restrictions and deflation in an endeavour to get inflation under control. In 1975 circumstances, however, under-employment of capacity was so great that even cautious finance ministers were motivated to reflate, as expanding output could reduce unit costs significantly in most industries. In addition, such reflation would be largely self-financing through taxation on increasing income, sales and profit, and declining costs of supporting the unemployed. This logic would be increasingly appealing in countries where the budget deficit was likely to reach record levels in 1975.

All these considerations were already in the pipeline. To them we added the consequences of continuing recession on the sociopolitical scene, where unemployment was probably the most explosive issue. Long-term unemployment for several million OECD adults could result in feelings of exclusion from society and fears for redeployment of skills. Most significantly, unemployment would fall on the young: there would be many unable to secure satisfactory employment. Few governments could face the prospect of a third successive class moving from school desk to the welfare rolls without being seen to act.

The Uncertain Part: Three Scenarios for "the Rapids"



The world knows now how to reflate but accidental shocks defer recovery.

Two Scenarios for "The Rapids"

The sum of all these factors pointed almost overwhelmingly to a change of course. In the face of inevitable uncertainty as to the pattern of future events and their timing, we created two scenarios and one contingency to span the probably range of developments, see Exhibit 18.

1. Depression Contingency

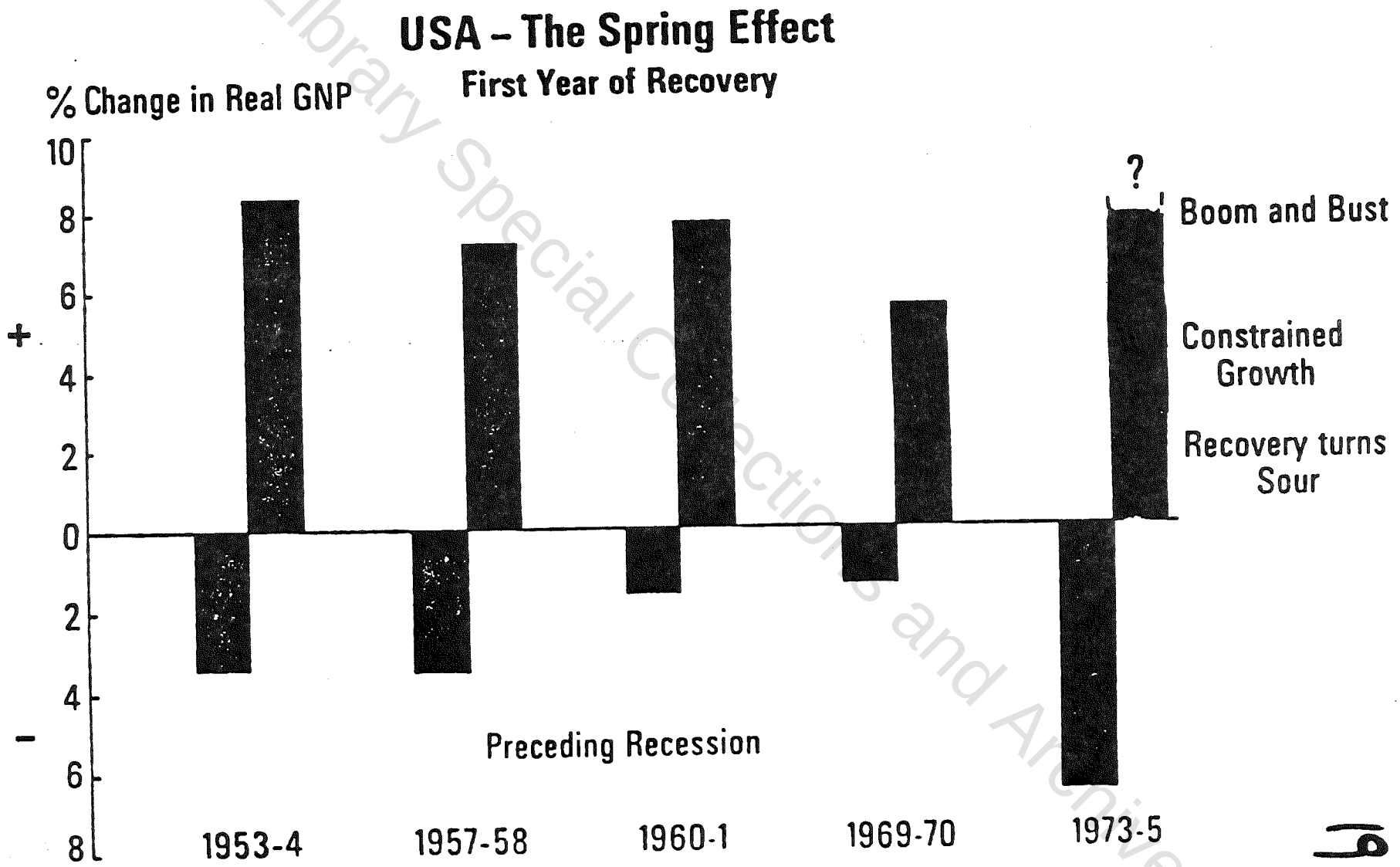
This contingency ("DC"), not a scenario relevant for planning, described an extended recession or depression lasting up to two more years. It seemed improbable considering the weight of the factors calling for reflation, the fact that governments knew how to reflate economies, and the low likelihood of events powerful enough to stop governments, faced with their own downfall, from reflating.

2. Boom and Bust

This scenario ("BB"), described a world which develops in cycles of greater amplitude and shorter duration than those of the 1960s, more characteristic in fact of the 1950s. It was clear that the longer the recovery would be deferred, wittingly or otherwise, the more likely this scenario would become as governments turned to panic measures to reflate their economies.

This scenario was based on apparent surprises. We compared these surprised to the rabbits a magician pulls out of his hat. All adults are well aware that the magician cannot produce rabbits which are not in the hat in the first place. Our rabbits were already in the hat.

First Surprise - Recovery Could Be Very Rapid. The first surprise would be the rapidity, strength, and forcefulness of economic recovery. It would not be abnormal, for instance, to see the U.S. economy grow by 11 to 12 percent in eighteen months. This would be equivalent in

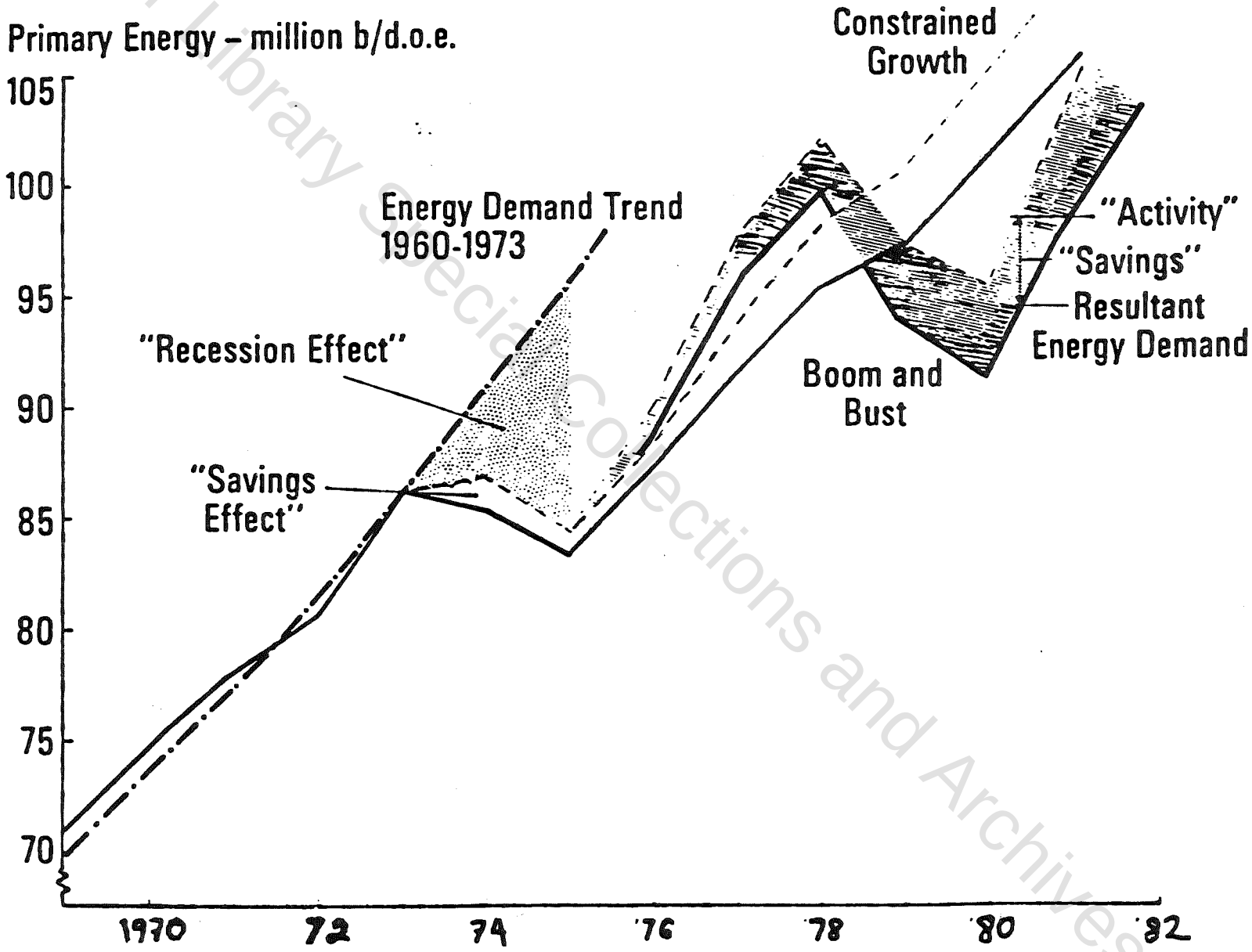


GNP terms to the appearance of an economy the size of the U.K. with its fifty-five million inhabitants, on the world map in this short time span. The potential for this lay in the depth of the then current recession and the amount of production potential under-employed, which, like a compressed spring, would be sufficient to sustain very rapid growth for a short period. An annual growth rate of 8 percent, typical of past booms, would certainly not imply spectacular achievements but only reflect the depth of the dent in the economy (see Exhibit 19).

Second Surprise - The Recovery Could Be Oil-Intensive. The energy intensity of the coming boom would constitute the second surprise. Newspapers full of accounts of energy savings would compel the intelligent layman to believe that "Western" responsiveness would largely negate OPEC's initial negotiating strength. This, however, could not stand up to analysis. The largest single factor reducing oil consumption had been the extent of the recession, which had cut both industrial and consumer demand, rather than any fundamental change in behavior. A boom in 1976 or 1977 would find the majority of consumers reverting to their previous patterns of behavior. Energy savings would be very important in the 1980s, when it might be surprising how much GNP can be increased without increasing energy use. Not, however, in 1976/77, when growth would be fueled by a major increase in demand for energy, and particularly for oil (see Exhibit 20).

Third Surprise - U.S. Oil Imports Could Boom. The third surprise would be the rapidity and the magnitude of the increase in U.S. oil imports. One could safely forget all about "Project Independence," all about President Ford's import reduction targets, and all about alternative energy projects. Our estimates indicated that in the first year of recovery U.S. imports would rise by 2½M b/d (i.e., more than U.K.'s total

WOCA Energy Demand – Recession and Savings



imports or Kuwait's current exports). In the second year there would be a further increase of 2M b/d, i.e., in aggregate more than U.K.'s total energy consumption. We had seen that normal recovery in the USA would be the equivalent to the sudden creation of a new economic nation, somewhat larger than the U.K. We could now add that this new nation, like Japan, would be almost totally dependent on oil from the Middle East. Consumer countries would once again realize that they were in a trap and their recovery was entirely in the hands of a few Middle East governments.

Fourth Surprise - Alternative Energies Would Be Stagnant. The fourth surprise would be the discovery that the alternative energy programs consisted largely of empty words and paper tigers. Most nuclear plants operated well below design capacity and a great number had been deferred or cancelled. In the coal sector, little had been done, and the OECD nations were slipping progressively further behind their target forecasts. The world was far removed from the "crash programs" of which we had heard so much in the dark days of the oil embargo. All in all, consumer nations would find themselves once more back in a trap.

Inflation Takes Off Again

The next threat in the Boom and Bust scenario was high levels of inflation--approaching hyperinflation in many of the weaker OECD nations. In broad terms the rate of inflation would exceed the highest levels of 1973/75 plus a further 5 percent as indicated in Exhibit __. These levels would be intolerable in sociopolitical terms.

The "Bust" or Second Recession

Very high levels of inflation would be the signal to governments in the industrialized world that the boom was getting out of control. They would have little choice but to reapply the deflationary measures so

PROBABILITY OF SCENARIOS STARTING:

	MID-1975	MID-1976
CONSTRAINED GROWTH	.60	.30
BOOM and BUST	.30	.65
DEPRESSION CONTINGENCY	.10	.05

recently removed. Credit restrictions would be imposed and interest rates would climb. Import controls might appear here and there and measures to reduce the consumption of oil imposed. Just as reinflation was likely to have been surprisingly rapid, so the downturn could be very sharp. Inventories would play an important role: stockbuilding, starting from depths of the current recession, would contribute to the growth of production during the upswing. As liquidity disappeared in the face of strong deflationary measures, stocks would be run down rapidly, making the downturn that much sharper.

Probability Assessment for "Boom and Bust"

We felt that this scenario's dramatic implications for all sectors of the world economy made it difficult to be objective and give equal attention to the other scenarios. Nevertheless, we did consider it less probable than Constrained Growth. We would make no forecasts about when a boom could start; we believed that it could take off at any time from third quarter 1975 onwards. Whatever the timing, the longer recovery took to get underway, the more likely it would be of the "Boom and Bust" variety. (See Exhibit 21.)

3. The "Constrained Growth" Scenario

The "surprises" outlined earlier were actually all implicit in a normal recovery. With the Constrained Growth ("CG") scenario we presented a genuine surprise, a trend-break, a major change in orientation: a general malfunctioning of the world economy, as we had come to know it, that would lead to a long-term scenario called the "World of Internal Contradiction" (WIC), introduced in 1974, summarized below.

The central idea of the WIC scenario was that the post-World War II world, with its underlying high growth trend had come to an end, and

this was not simply a result of an oil shock or the end of the Bretton Woods monetary order. The very success of the postwar economy had sown the seeds of its destruction. With the speed and magnitude of growth came expectations in standards of living, which led to a new kind of rigidity as governments generated fixed overhead costs for their social programs. This made governments slower to change and adjust to new factors--in their response to an energy crisis, or to new competitors like Japan and the expanding economies of Southeast Asia.

In addition, the WIC scenario analyzed each of the four motors of economic growth--consumption, international trade, government expenditure, and investment--and concluded that each would work with less power over the ensuing fifteen years. Investment was particularly emphasized, as its change would be quickly felt and dramatic. We called the change "technological recession."

From the end of World War II until the early 1970s, the best new technology could replace on its own merit existing technology in basic industries. A new steel plant was regularly more economic than an existing one per ton of capacity, a new cement plant per ton of capacity, a new paper plant, a new power generation plant per kilowatt of capacity, a new refinery, a new tanker, a new cat cracker per ton of capacity. But from the late 1960s to the early 1970s, technological progress became incapable of beating inflation and economies of scale had reached a limit. To get new capacity, the cheapest method was not to build a new plant but to acquire existing capacity. Thus, there was both a slowdown in technical progress and increasing inflation--technological recession.

It was felt at Shell that, at least temporarily, and perhaps for ten to fifteen years, a situation had been reached wherein the unit capital

and operating costs of almost all new plant in basic industries exceeded those of existing equipment. This was a major discouragement to new investment in most industries that had been the engine of economic growth since the war, and would result in a structural change in the global economy. It could further accentuate inflation in any future upturns. Similar analyses were done for the other motors of growth: government spending (budget deficits and the reduced degrees of liberty); consumer spending (increasing maturing in the life cycle of a large range of consumer durables); and international trade (accumulating imbalances and frictions).

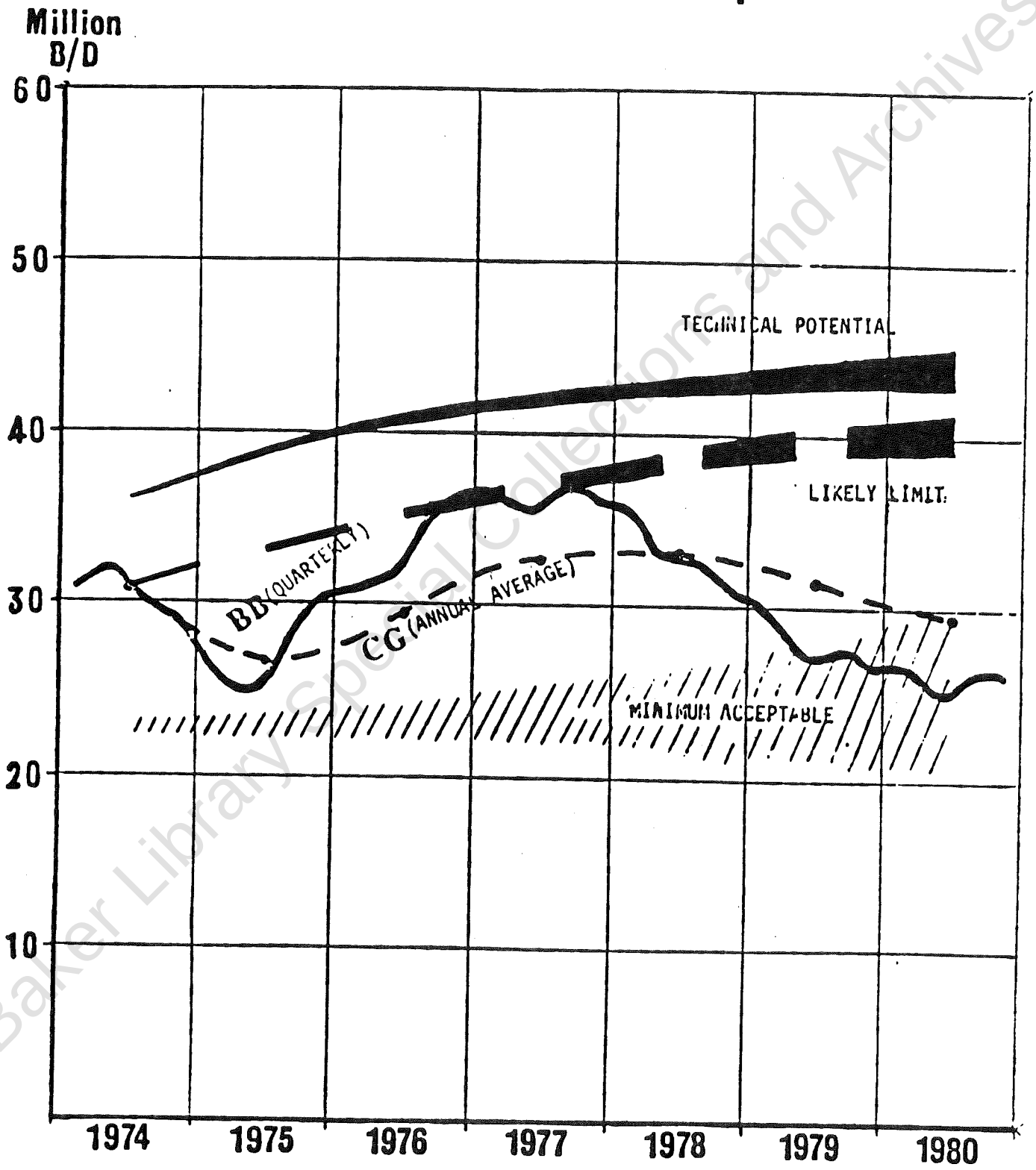
As a conclusion, economic growth prospects were perceived to be well below past achievements and the trends of the sixties and early seventies, and we would enter a new world as yet unheard of during the last twenty-five years: the "world of internal contradictions" and "constrained growth."

FOCUSED SCENARIOS

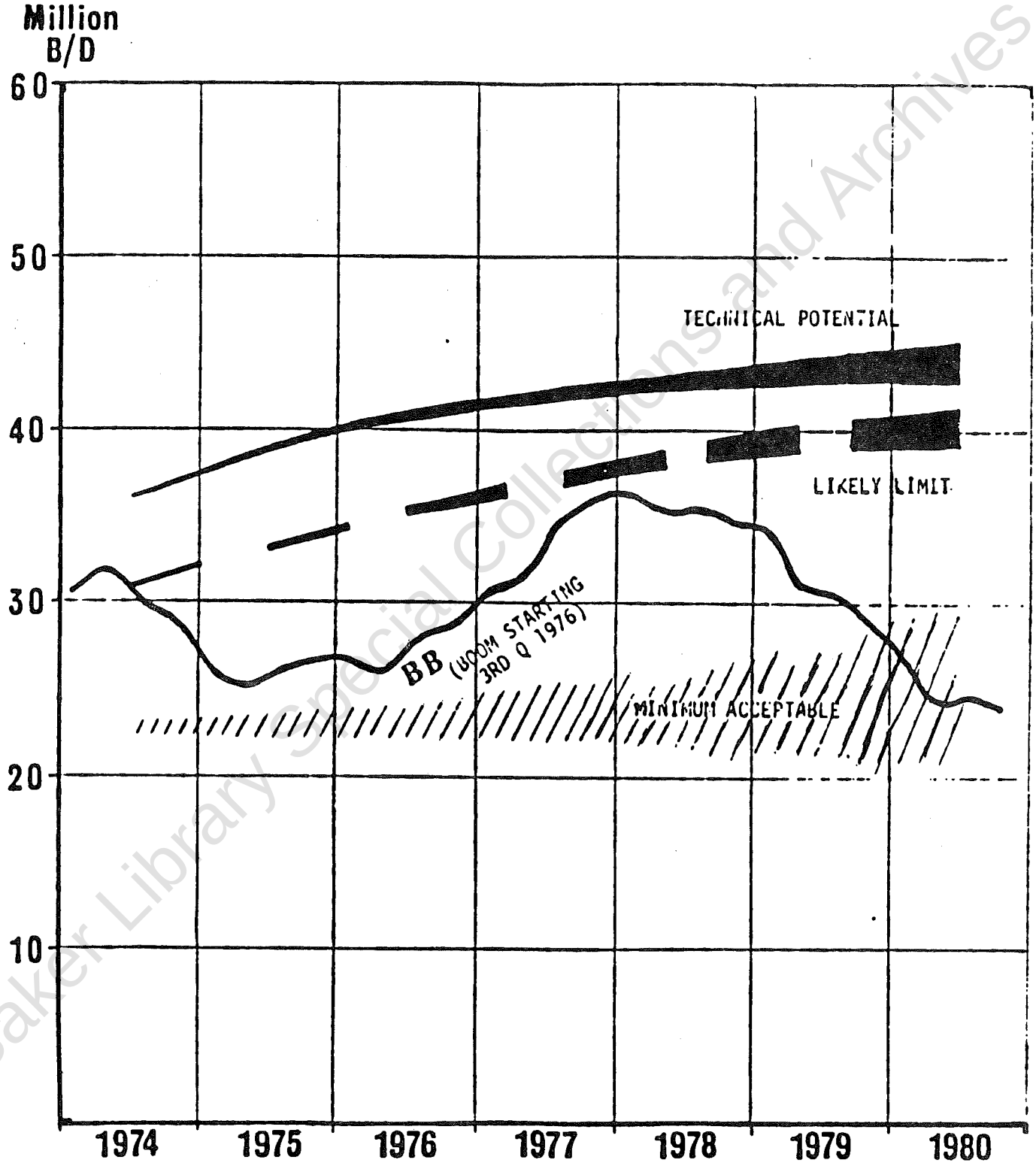
From one viewpoint, scenarios are like cherry trees: cherries grow neither on the trunk nor on the large boughs; they grow on the small branches of the tree. Nonetheless, to grow small branches, a tree needs a trunk and main branches.

The global, macro-scenarios just described are the trunk; the large branches are the country scenarios developed by Shell national companies, in which factors individual to the countries--predetermined and uncertain--are taken into account and added. But the real fruits of the scenarios are picked at the small branches, the focused scenarios, custom

OPEC: Production Boundaries and Seasonal Requirements



OPEC: Production Boundaries and Seasonal Requirements



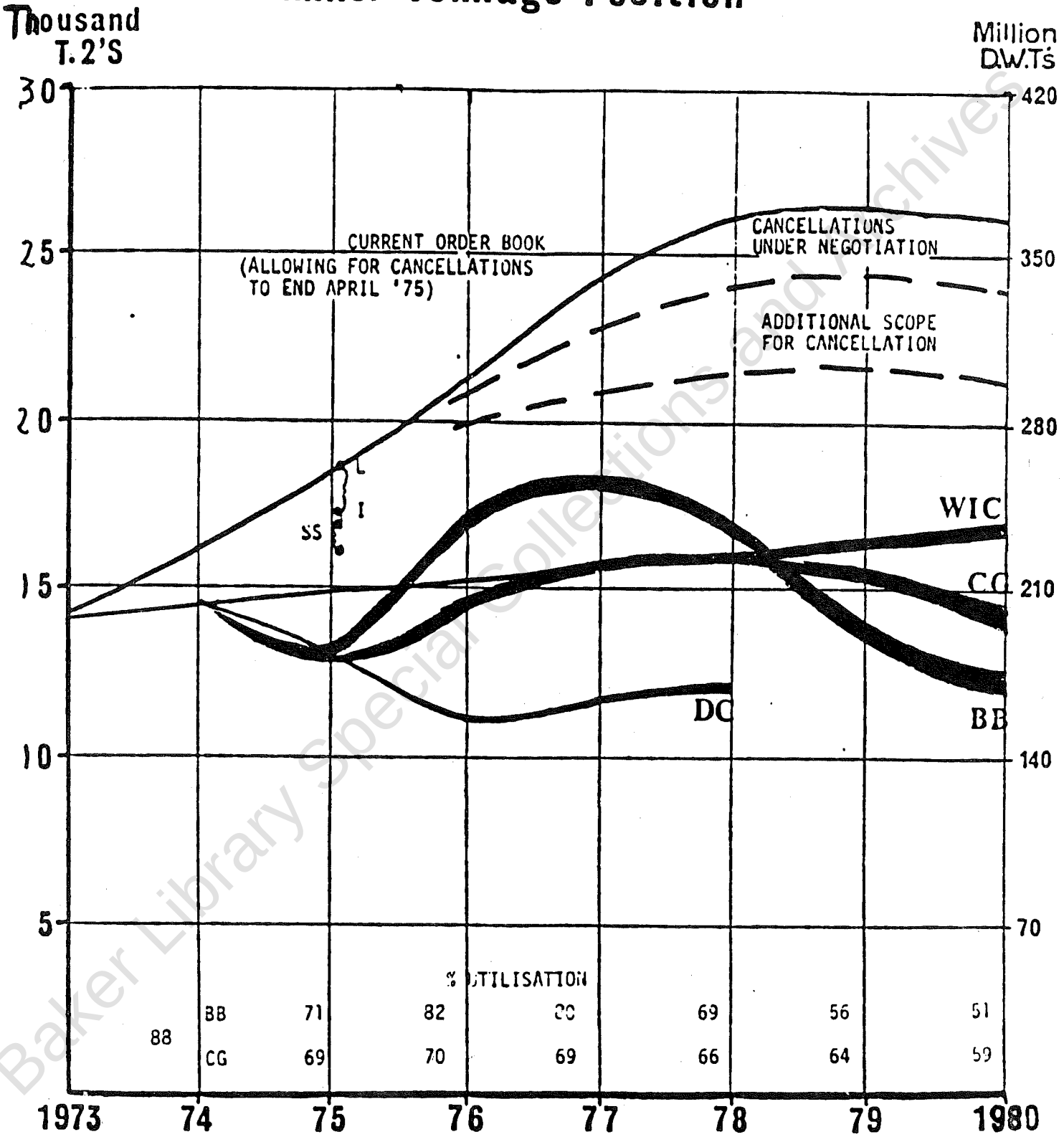
tailored around a strategic issue or a specific market or specific investment projects. Two examples of focused scenarios follow.

1. As OPEC oil is the balancing factor in the world energy system, its fluctuations reflect, but several times amplified, the economic cyclical fluctuations. Because energy intensive industries (like cement and steel) are more than proportionally affected in a recession as in a recovery; because nonoil energies are usually cheaper than oil; and finally because OPEC oil has to be paid in foreign exchange as opposed to domestic oil, a given percentage of decline in economic activity is translated into a larger decline in world oil consumption and into a much larger decline in OPEC oil demand. Conversely, in a recovery, a small increase in world energy demand would be translated into a larger increase in oil demand and a much larger increase in OPEC oil demand. In the Boom and Bust scenario, a 13 percent increase in world energy demand in the first two years of a recovery would be translated into a 23 percent increase in world oil demand and into a 34 percent increase in OPEC oil demand.

The fluctuations of OPEC oil develop in a narrow band between two danger zones (see Exhibit 22): the upper one, dangerous for oil-consuming countries, starting from the technical product capabilities, is set by what is called "OPEC willingness to produce"; the lower one, dangerous for oil-producing countries, is the threshold of "OPEC dissatisfaction" where the solidarity and discipline of OPEC comes under severe stress and when prices might erode.

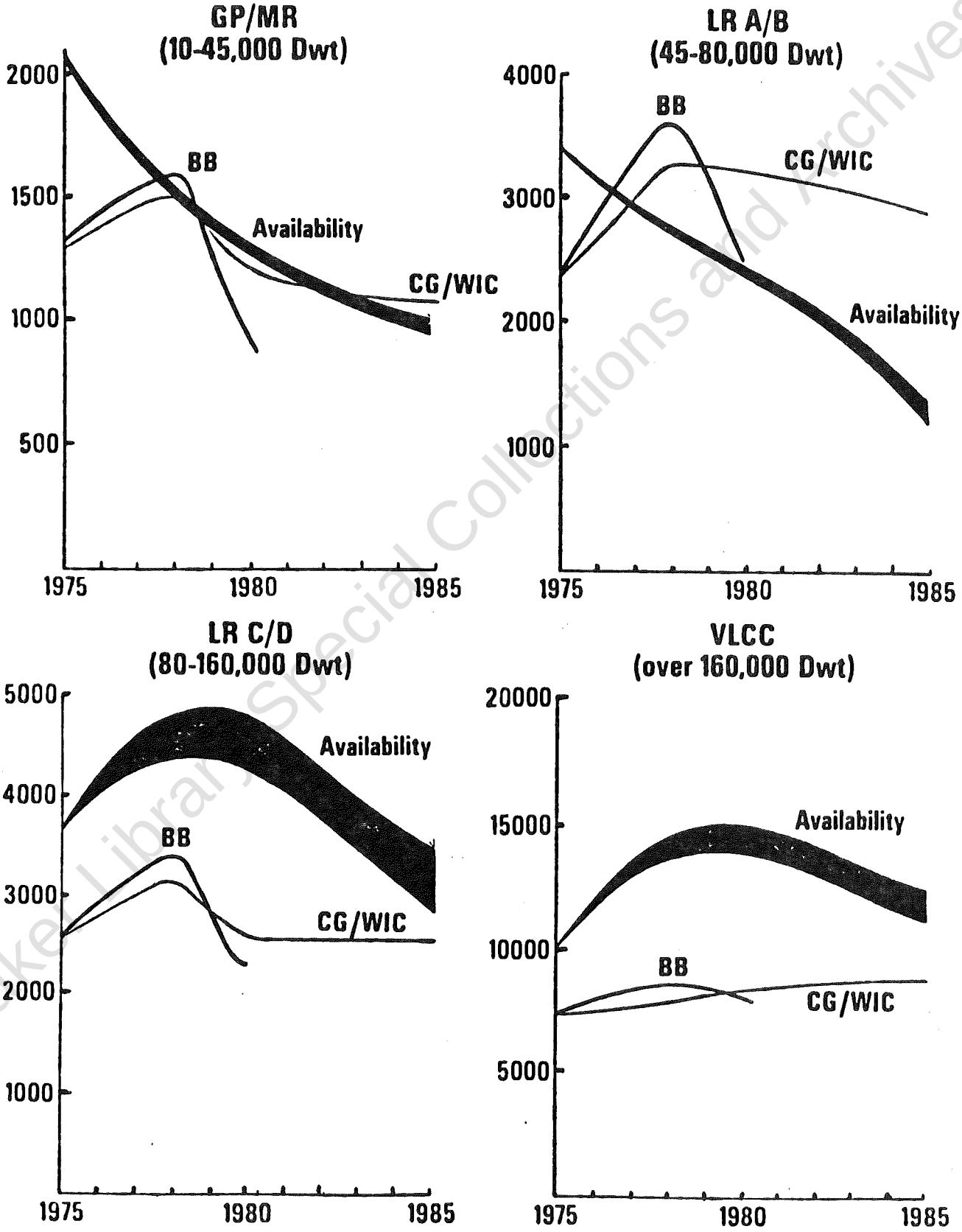
We made two simulations (Exhibit 22 and Exhibit 23). The changes implicit in a normal boom starting late 1975 would become clear in winter 1976-77, with supply dangerously tight and prices severely pressured. A boom starting only in late 1976 would be less dangerous.

Tanker Tonnage Position



L = lay-up I = idle SS = slow steaming

Tankage Tonnage Position – Analysis by Class
(T2's)



2. Exhibit 24 and Exhibit 25 show the implications of the scenarios focused on the tanker market, first globally, then by class of tankers. The charts are self-explanatory.

Conclusion to be developed in class.