AU/AWC/RWP010/96-04

AIR WAR COLLEGE

AIR UNIVERSITY

STRATEGY AFTER OIL

IN THE TWENTY FIRST CENTURY

by

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A Paper Submitted To the Faculty

In Fulfillment Of the Curriculum Requirement

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Maxwell Air Force Base, Alabama

1 April 1996

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Preface

I come from the United Arab Emirates, an oil producing country on the Arabian Gulf. In my country, we first discovered oil in the late 1950s and started production in the early 1960s. As the government received the first revenues from oil, the country commenced a rapid development process in every aspect of life. Today, the U.A.E is one of the most modern countries in the Middle East and the Far East. The country contains large amounts of oil and gas reserves. At present rates, production can continue for over a hundred years.[1] Other countries in the Gulf possess a similar wealth of oil, and together, these countries contain the largest amounts of oil reserves in the world.[2] While observing the development and the economic growth of my country, I started appreciating the value of this natural resource. Oil has been, and still is, the primary means of our prosperity and power. It is a national resource that we treasure and protect dearly. Actually, we consider oil to be "black gold."

For many years I wondered, how much longer can the world continue to use oil. Although, it is not a renewable source of energy, many countries of the world consume oil in huge quantities. Primarily, oil is the main source of energy for transportation. It operates millions of cars, planes and ships around the world. Without this source of energy the world will come to a halt. Employees cannot get to their offices. Workers can not reach their factories. Students can not go to their schools and universities. Also, no goods can be transported around the world, not even between cities. Logistically, all

military operations depend on oil. Without it, military deployment and employment can not take place. Briefly, almost all transportation means land, sea and air run on oil. The combustion engine has been the king of inventions during this century.

As I conducted my research, I realized how crucial oil is to the world. Oil has been, and continues to be, the main source for development and technological advancement. Actually, economic growth in the world depends on oil. The interruption of oil supply during the 1973 oil crises had a serious impact on the industrial world. Mainly, it affected Western Europe, Japan, and the United States. Manufacturing and industries in these nations came almost to a halt. The crisis prompted these nations to seek permanent solutions to such a problem in future. Scientists and energy specialists, particularly in the United States and Europe, started a campaign in order to find energy substitutes and more efficient uses of energy. They began looking for methods to conserve oil and suggested temporary measures to deal with the problem. The United States Government, under President Carter, formed the Rapid Deployment Forces to prevent any interruption of oil supply by military force. Japan and Western Europe, on the other hand, decided to adopt moderate policies towards the Middle East countries.

As a result of the 1973 crises, the Organization of Petroleum Exporting Countries (OPEC) controlled production and continued to raise oil prices throughout the 1970s and the1980s. This deepened the effect of the crises on the industrial nations. Their governments had no choice but to accept what OPEC imposed on them. However, In the long run, they remained determined to overcome OPEC. Today, another oil interruption remains a serious concern to the industrial nations, and indeed the 1990-91 Gulf War demonstrated the importance of oil to these nations. On the other hand, the world today

faces the problem of the green house effect and global warming. Burning oil is damaging the atmosphere and the environment. In less than a century, the world will face a disaster.[3]

This paper speculates on the future of oil energy and the oil strategy during the 21st century. Although, there are many books on the subject, this paper will offer a different perspective. Here, I will present a new dimension to the energy problem.

During the 21st century, the world will witness the end of the oil age. By the year 2005 the world will start a gradual shift from using oil to other energy substitutes. Around the year 2025, major industrial nations will completely stop using oil as a source of energy, as they switch to other alternatives. Other nations, however, might follow a few years later depending on their economy and capabilities. Most certainly, this will deeply affect many countries of the world, especially the oil producing countries, unless they make preparations for it today. The transition period will last about 20-25 years, and the resulting transformation will widen the gap between technologically advanced nations and developing nations. Policies and strategies of the industrial nation will change completely after the transition has been completed. The dramatic change will affect all countries of the world at different degrees.

This discussion focuses on the United States because it is the largest consumer of oil in the world and the most advanced among industrial nations. It also focuses on the Arabian Gulf region because it is the largest producer of oil and carries the largest reserves worldwide.[4] This paper discusses oil energy issues and associated strategies in three parts. The first part provides background on energy, the second presents past and future oil crisis in terms of the fate of oil energy, and the third part discusses past, present

and future energy strategies. The intention is to highlight a serious problem the world will face in the intermediate future.

Notes

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Chapter 1

Energy Background

When talking about energy, the basic question a person might ask, what is energy? One definition is, "Doing work requires the capacity to do work, this capacity is called energy."[1] But, in economical terms, energy is "The driving force, the universal factor, that enables people to convert natural resources to useful goods and services."[2] In fact, energy is the heartbeat of society and the means for their survival. Today, Oil and gas provide about 70 percent of the energy consumed in the United States.[3] In order to manufacture goods and produce services, we require huge amounts of oil energy. In extreme cases, for example, it takes 10 million barrels of oil to build an aircraft carrier. [4] To operate a battle group during its life cycle, it consumes approximately 64 million barrels of oil. Thus, to utilize many of the products, we need considerable amounts of this energy. Moreover, to dispose of them or to recycle them also requires additional amounts of energy.

The agriculture and food industry depends entirely on oil energy, "The production of food has become almost totally dependent on oil and gas, not only to provide the chemicals and machinery now used on our farms, but also to process and distribute products."[5] Transportation requires enormous amounts of oil energy as it consumes about 60 percent of the total domestic and imported oil[6]. We use oil energy to provide electricity in order to run the factories, to light homes and offices, and to keep these

places warm in winter and cool in summer. Briefly, oil has become the most essential source for the survival of a nation.

Today, there are a variety of energy sources that are known to man. These are categorized into two main types: The non-renewable sources, such as oil, gas, coal, oil shale, and nuclear. Once consumed, these sources cannot be replaced, and burning fossil fuels causes damage to the environment. The renewable sources, such as, solar, hydropower, and wind power are infinite and using them causes hardly any damage to the environment. Today, many industrial nations are conducting research on both types of energy sources in order to develop fuel substitutes for oil and gas.

Oil is the only energy source that is completely developed and readily available for all purposes. Compared with other sources, it is the most cost effective.[7] While oil reserves are sufficient to lead the world into the 21st century, it remains a sad fact that "the world uses oil and gas at least 10,000 times faster than the earth's geological process are replacing it."[8] While all other sources are considered possible alternatives to oil, their uses are limited to specific functions and the price to obtain them is relatively high. In their research for developing alternatives, scientists consider the nonrenewable types of energy to form the hard path solution, and the renewable types to form the soft path solution.[9]

Some of the energy alternatives are well developed, but the problem remains that they can be used only for limited functions. Moreover, all other types of energy are less cost effective than oil. Examples of such energy sources are coal, hydroelectricity and conventional nuclear fission power. At present, all the alternatives are at different stages of development. Some are well into the final stage and have proven some success in

replacing oil.[10] Today, the fact remains that about two thirds of the world energy comes from oil and natural gas which is associated with oil discoveries.[11]

For many centuries, coal was the main source of energy. In the 19th century, the industrial revolution in Europe was based on coal energy. The peak of all inventions during that time was the steam engine. It brought about a complete transformation of life for the society. Manufacturing and industry developed very fast, as local markets were flooded with goods and products. Transportation depended on coal and steam and operated trains, ships and many other vehicles. Technological advancement and economical growth, however, were relatively slow by today's standard. The discovery of oil in the 1850s, brought about the modern revolution, technology took a large leap into the 20th century. Coal was largely abandoned for oil during this century. The invention of the internal combustion engine made the world a global village. Land, sea and air transportation developed quickly. The aircraft was invented in 1905 and the oceans were linked together. As goods were easily transported, markets continued to spread around the glob and the world became a market place for industrial nations. Hence, production had to increase to match global demand.[12]

Today, many people argue that this century is the "Nuclear Age." Although nuclear power was expected to offer a lot more for humanity, it mostly caused destruction rather than construction. There is no doubt in my mind that this age is "The Oil Age." The benefits of oil energy have surpassed all other sources of energy by many folds. We have to remember that oil has taken us to space when no other source of energy did. Today, oil enables us to search for alternatives.[13]

To appreciate the value of oil and the nature of the problem, we have to understand several facts about energy. Most important, is how to evaluate the quality of an energy source and compare it to others. Simply, the best quality of energy source, is the one that requires the least amount of energy to extract it and to process it in order to make it available for use. After using it to provide goods and services, this energy must provide a surplus to reproduce energy. Thus, to obtain energy requires the expenditure of energy. The expenditure of energy includes, in addition to providing goods and services, the extraction of the source and making it available for use in the same manner. For example, "if it takes 50,000 barrels of oil (or the heat equivalent in other fuels) to do everything necessary to tap into a particular oil field, and if the field ultimately yields a million barrels of oil, that oil has an energy profit ratio of 20, and society will receive 950,000 barrels of oil in net energy. These 950,000 barrels, not the original million, are the energy we use to fill up our cars' gas tanks, heat our homes, and power the rest of our economy."[14] If the amount of energy required to extract and process a source of energy is higher than the energy contained in that source, this means we will lose energy. Thus, this source can be classified as having a low energy quality. The quality of energy can be measured by what is called the energy profit ratio. "The costs of fuels can be expressed elegantly by what we call the energy profit ratio. This energy profit ratio is the energy in the fuel produced divided by the energy used to produce it. High quality fuel have a large energy profit ratio, reflecting the small amount of energy they take to produce. The energy profit ratio is tremendously useful yard stick for comparing different fuels or different sources of the same fuel, since it is a direct measure of a fuel cost, as opposed to its value."[15]

Obviously, high quality energies must have an energy profit ratio much higher than one. After subtracting the energy required to obtain a source, the surplus of energy it contains will make it possible to manufacture goods, to operate the transportation system, and to put food at our tables. Table 1, illustrates the energy profit ratios for different sources and or fuels.[16] Only energy resources that can provide a ratio above one are considered reserves.[17] With this in mind, many energy sources in the ground do not provide an energy profit ratio of more than one. Hence, not all natural resource available are considered reserves. Today, all alternative energy sources, including coal, have a much lower quality compared to oil. So, oil and gas have the highest qualities among all sources of energy. Importing oil by the industrial nations will be lucrative only if the price of oil can provide enough energy to manufacture goods and provide services that contain a higher value than the oil bought. In other words, the capacity to do work will be determined by the value of the energy. "The energy profit ratio for imported petroleum is the ratio of energy contained in a dollar's worth of imported fuel divided by the energy used to make a dollar's worth of exports. For example, in 1979 a dollar bought the United States about 47,000 Kcal of oil, while it took 7,000 Kcal to produce a dollars' worth of exported goods."[18] This means, the prices of oil will determine its quality as a source of energy. Thus, it is obvious that oil as a natural resource is extremely vital for technological advancement and economic growth, "Oil has, in fact, shaped both economic growth and modern life."[19] Today, the power and prosperity of the industrial nations depends primarily on it. Actually, "It is certain that oil has made the United States the world's biggest economic, agricultural, and military power, and the Soviet Union the second biggest. The United States and Western civilization is oil."[20] Since oil has the

best quality among all energy sources and is abundant, why are major industrial nations seeking to replace it?

Two main factors are probing those nations to find alternatives to oil before they are forced to abandon it. First, in a few years, the distribution of oil reserves will become completely unbalanced. Several developing nations will have huge reserves of oil, while the industrial nations will have small or no reserves. This unbalance will render the industrial nations vulnerable to any interruption of oil supply, and hence will threaten their survival.[21] As the demand for oil in the industrial nations is growing fast, the prices of oil will increase. This will reduce the margins for economic growth and prosperity in those nations.[22] Second, in the long term, the emission of toxic gases from burning oil is threatening the environment and life on earth. The green house effect and global warming is a serious problem. In the short term, this will impose extra economic burdens on industrial nations as they attempt to reduce emissions of toxic gases.[23]

Table 1. Estimated Energy Profit Ratio for Existing Fuels and Future Technologies

Process	Energy Profit Ratio
1. Nonrenewable	
Oil and gas (domestic well head)	
1940s	Discoveries > 100.0
1970s	Production 23.0, discoveries 8.0
Coal (mine mouth)	
1950s	80.0
1970s	30.0
Oil Shale	0.7 to 13.3
Coal liquefaction	0.5 to 8.2
Geo-pressured gas	1.0 to 5.0
2. *Renewable*	
Ethanol (sugarcane)	0.8 to 1.7
Ethanol (corn)	1.3
Ethanol (corn residues)	0.7 to 1.8
Methanol (wood)	2.6
Solar space heat (fossil backup)	
Flat-plate collector	1.9
Concentrating collector	1.6
3. *Electricity production*	
Coal	
U.S. average	9.0
Western surface Coal	
No Scrubbers	6.0
Scrubbers	2.5
Hydropower	11.2
Nuclear (light-water reactor)	4.0
Solar	
Power satellite	2.0
Power tower	4.2
Photovoltaics	1.7 to 10.0
Geothermal	
Liquid dominated	4.0
Hot dry rock	1.9 to 13.0

Source: C.J. Cleveland, R. Costanza, C.A.S. Hall, and R. Kaufmann, "Energy and the U.S. Economy: A Biophysical Perspective," *Science* 225 (1984): 890-97, 1984 AAAS.

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[2] Ibid., 75.

[3] *Compton's Interactive Encyclopedia*, 1994, 1995 Compton's NewMedia, Inc. "Petroleum.," 1.

[4] John Gever, Robert Kaufman, David Skole and Charles Vorosmarty, *Beyond Oil, The Threat to Food and Fuel in the Coming Decades.* Complex Systems Research Center University of New Hampshire. A Project of Carrying Capacity, Inc. (Allinger Publishing Company, Cambridge, Massachusetts A Subsidiary of Harper & Row, Publishing, Inc. 1985), 100.

[5] Ibid., 14.

[6] United States. Congress. Senate. Committee on Energy and Natural Resources. *Key Elements of a National Energy Policy.* One hundred first congress, second session. October 2,1990, 18.

[7] John Gever, Robert Kaufman, David Skole and Charles Vorosmarty, *Beyond Oil, The Threat to Food and Fuel in the Coming Decades.* Complex Systems Research Center University of New Hampshire. A Project of Carrying Capacity, Inc. (Allinger Publishing Company, Cambridge, Massachusetts A Subsidiary of Harper & Row, Publishing, Inc. 1985), 87.

[8] Ibid., 12.

[9] Ibid., 130.

[10] John L. Petersen, *The Road to 2015, Profiles of the future.* Waite Group Press, Corte Madera, California. 1994, pp. 150-164.

[11] *Compton's Interactive Encyclopedia*, 1994, 1995 Compton's NewMedia, Inc. "Petroleum.,"1.

[12] *Compton's Interactive Encyclopedia*, 1994, 1995 Compton's NewMedia, Inc. "1802-the present: Transportation Revolution.," 1.

[13]John Gever, Robert Kaufman, David Skole and Charles Vorosmarty, *Beyond Oil, The Threat to Food and Fuel in the Coming Decades.* Complex Systems Research Center University of New Hampshire. A Project of Carrying Capacity, Inc. (Allinger Publishing Company, Cambridge, Massachusetts A Subsidiary of Harper & Row, Publishing, Inc. 1985), 249.

[14] Ibid., 52.

[15] Ibid., 51.

[16] Ibid., 70.

[17] Ibid., 39.

[18] Ibid., 76.

[19] Ibid., 109.

[20] Ibid., 248.

Notes

[21] Donald L. Guertin, W. Kenneth Davis and John E. Gray, *U.S Energy Imperatives for the 1990s, Leadership, Efficiency, Environmental Responsibility, and Sustained Economic Growth.* (University Press of America, Inc. 1992), 19.

[22] John Gever, Robert Kaufman, David Skole and Charles Vorosmarty, *Beyond Oil, The Threat to Food and Fuel in the Coming Decades.* Complex Systems Research Center University of New Hampshire. A Project of Carrying Capacity, Inc. (Allinger Publishing Company, Cambridge, Massachusetts A Subsidiary of Harper & Row, Publishing, Inc. 1985), 65.

[23] Ibid., 71.

Chapter 2

The Oil Crisis

In the past, the industrial world faced three major oil crises that left deep scars on the world economy and in all likelihood, the world is destined to face two more energy crises, which are different in nature before oil can be successfully replaced. The first oil crisis in the past revealed the vulnerability of the industrial nations and their complete dependency on oil, "The low oil prices in the decades following World War II provided the world economy with an essential level of stability and deepened the world's dependency on oil."[1] In the 1973 Arab-Israeli war (Ramadan war) on the 6th October, Middle Eastern Arab countries were discontent with Western nations for backing Israel politically, economically and militarily. Arab leaders, in the oil producing countries decided unanimously to impose an embargo on selling oil to those nations.

For the first time, Arab countries used oil as an economic weapon to force Western nations to alter their policies towards the Middle East conflict. Their decision made many industrial nations, especially Western Europe, Japan and the United States, seriously suffer during that winter. Many manufacturing facilities stopped production. People were queuing for hours at gas stations to get some gas when it was available. In the United States, cars with odd and even number plates were allowed to take up gas on alternative days only. Winter was harsh in every home in Europe for there was no alternative heating

system available. In Washington, President Carter addressed the nation on national television, while sitting near a fireplace in the White House. He talked to the people about the crisis, and promised to take action to restore the situation. In the mean time, he urged the nation to conserve energy. In Japan, almost every function in the nation came to a halt. As a result of this crisis, when oil sales resumed to the industrial nations, the prices of oil had doubled (Table 2). Industrial countries had no choice but to pay for the increase in price just to get the oil. Thus, the energy profit ratio reduced, and the margins for economical growth reduced too. Since that time, oil-producing countries realized they had substantial leverage over the industrial nations. Through OPEC, they controlled oil production by assigning quotas to member states, and thus this was their policy to control oil prices.[2]

Table 2. Oil Prices in U.S., Dollars Per Barrel (1946-1992)

Year	$	Year	$	Year	$
1946	1.41	1962	2.9	1978	9
1948	2.61	1964	2.88	1980	21.59
1950	2.51	1966	2.88	1982	28.52
1952	2.53	1968	2.94	1984	25.88
1954	2.78	1970	3.18	1986	12.51
1956	2.79	1972	3.39	1988	12.58
1958	3.01	1974	6.87	1990	20.03
1960	2.88	1976	8.19	1992	15.98

Source: Energy Statistics Sourcebook, (Tulsa, Okla.: Penn Well Publishing Company, 1993), p. 382.

Year after year, oil prices kept increasing steadily until 1979, when just before the second crisis, oil prices had almost tripled (Table 2). The second oil crisis started with the Iranian revolution and continued aggravating with the outbreak of a serious war in the Arabian Gulf. Towards the end of 1980 Iraq attacked Iran with the objective of capturing the territory it claimed in "Shutt Al Arab." This war lasted for about eight years. At the outbreak of war, oil prices had doubled again in 1980. After couple of years into the war, prices increased once more, registering a high $28 pbr. (Table 2). By 1984-86, the two belligerents started an oil war by targeting oil installations in both countries. As members in OPEC, they also violated the oil quotas assigned to them and began to flood the market with oil at very low prices. They competed for selling more oil because they needed the money to fund the war. This resulted in undercutting OPEC control over oil production and oil prices. Other member states also were forced to violate their quotas in order to keep their economy intact. In 1986-88 the prices of oil had fallen to almost less than half. Although the tanker war during that period had jeopardized the free navigation in the gulf, oil markets remained flooded with oil and the prices remained at their margin.[3]

The Iran-Iraq war resulted in a stalemate. During the eight years of war both countries suffered considerable destruction and much of their economy was crumbling. The only way they could survive or rebuild their economy was to sell more oil. Toward the end of the war, OPEC had lost control over oil markets. A fierce competition for selling oil had begun between member states in OPEC. Thus, for the Industrial nations, Iran-Iraq war was initially a threat to their survival and well being, but later it became a blessing. The fact remains that much of the black gold was wasted midst the war. Regardless of how much oil could Iraq sell, prices were never enough to revive its

economy. Although Iran and Iraq started the game of flooding the markets with oil, the Iraqi government blamed other Gulf states for causing the oil prices to plunge down. Particularly, it accused Kuwait and the United Arab Emirates for exceeding their quotas, thus causing the low prices. On 17 July 1990, the Iraqi government claimed that both these states had seriously damaged the Iraqi economy and considered their act to be an aggression against Iraq. Eventually, on 2 August 1990, Iraq used this accusation as an excuse to invade Kuwait and start the Gulf War.[4]

The Gulf war had almost caused a serious oil crisis. Actually it was an attempt by Iraq to control the oil resources. If Iraq had succeeded to retain Kuwait, the total oil reserves it would have possessed, would account to 20% of the world oil reserve (Table 3). The Iraqi invasion of Kuwait caused apprehension and anxiety in the industrial world. As a result of the UN resolutions that imposed economic sanctions against Iraq, Iraqi and Kuwaiti oil was completely absent from the world market.

Table 3. Estimated Crude Oil Reserves in 1994 (in billion barrels)

Country		**Country**	
United States	23.7	Egypt	6.3
Canada	5.1	Algeria	9.2
Mexico	50.9	Libya	22.8
Venezuela	63.3	Iran	92.9
United Kingdom	4.6	Iraq	100
Norway	9.3	Kuwait	96.5
Former Soviet Union	57	Qatar	3.7
China	24	United Arab Emirates	98.1
Indonesia	5.8	Saudi Arabia	261.2
Nigeria	17.9	World Total	99.1

Source: Oil and Gas Journal, Vol. 91, Dec. 27, 1993,44-45.

Oil prices had jumped once again to about $20 a barrel (Table 2). Saudi Arabia had to increase oil production to compensate for the absence of Kuwaiti and Iraqi oil. While this action limited the effect of the crisis, the dangers of controlling oil sources by radical regimes remains a threat in the future. Today, Saudi Arabia continues to pump oil at its maximum capacity and oil prices have settled at $15 a barrel.[5]

Several factors are compelling major industrial nations to abandon oil energy for other substitutes. These nations are working rigorously on plans to replace oil by the end of the first quarter in the 21st century. If they do not succeed, they believe they will face two serious oil crises in the future: The first has to do with unbalanced distribution of oil reserves along with a higher demand for oil (Table 3). The second has to do with the environmental degradation from the continued burning of oil as the main source of energy. As mentioned earlier, "In few years time, the distribution of oil reserves will become completely unbalanced. While several developing nations will have huge reserves of oil, major industrial nations will have small or no reserves left." While some sources estimate that world wide oil reserves will last for about 60 years only, others estimate that it will last for more than a 100 years. In the year 2025, analyses estimate that remaining oil reserves will only be 12 percent.[6] What ever the case might be, more than 65 percent of the world oil reserves today are in the Arabian Gulf region, including Iraq and Iran. As the oil reserves are depleted elsewhere, the percentage of oil in the Gulf region will continue to increase year after year.[7]

Today, major industrial nations import most of their oil from the Middle East, particularly the Arabian Gulf region. "Of the seven major regions, Western Europe has the lowest oil production, roughly 4.3 million barrel per day (bpd), accounting to 7

percent of oil production world wide. With near term consumption oil demand exceeding 7 million bpd, the region faces continued reliance on oil imports principally from the Middle East."[8] Moreover, the energy profit ratio of the oil produced in Europe is relatively low. A shortage or an interruption of oil supply to Western Europe will cripple their economies. As the demand for oil increases, in few years Western Europe will have no reserves left. Particularly, if Eastern Europe's economy starts developing as expected, then all European countries will completely depend on imported oil.[9]

Japan today imports all its oil from other regions of the world, mainly the Arabian Gulf region. About 25 percent of the oil and gas needs of Japan come from the United Arab Emirates. "Japan continues in the most leveraged position, importing almost 98 percent of the domestic oil consumption demands."[10] The situation in other Far Eastern countries remains threatened in the future, especially with the present economic growth at about 8-15 percent. Today, however, they can barely meet their present requirement of oil. "China, Indonesia and Malaysia all produce sufficient oil to meet domestic consumption, although Chain's rapid annual industrial growth (over 12 percent) threatens that balance."[11]

Today, the United States is the largest consumer of oil in the world. It produces less than half its requirement and imports more than 50 percent from other countries, mostly the Gulf region. After the year 2000 the United States will import about two thirds of its oil requirement. By the year 2005 oil consumption in the US will increase by about 17 percent, however the production will drop by about 20 percent (Table 4). At that time "It will take more energy to explore for new US oil and gas than the wells will produce. Naturally we will continue to pump old oil fields after 2005-but not long after; US oil will

be virtually exhausted by 2020."[12] According to another observer, he concludes that by the year 2020 domestic oil supplies and gas will also be effectively depleted.[13]

Table 4. American Vulnerability to Oil from the Persian/Gulf (in million barrel/day)

	1990	1991	1992	2000	2005	2010
Consumption						
U.S.A	16.99	16.71	17.03	19.3	20.4	21.3
Production						
U.S.A	9.68	9.88	9.77	8	7.8	8.1
Canada	2.02	2.03	2.12	2.2	2.5	2.5
Europe	4.58	40.81	5.08	6.4	5.3	4.8
China	2.77	2.83	2.84	3.1	3.2	3.4
Russia	11.4	10.41	8.91	8.5	9.7	11
E. Europe	0.34	0.29	0.25	0.4	0.4	0.4
Other	11.12	11.34	11.72	13	12.3	12.1
OPEC	24.81	24.93	26.38	35.5	40.9	44

Source: Energy Information Administration, International Energy Outlook 1994, (Pittsburgh, PA: U.S. Government Office, July 1994).

The situation in other regions of the world is not any better. In the past, the USSR was considered a leading nation in oil production. Today Russia is facing serious problems domestically and the situation remains uncertain. With financial and political problems, the country is having a hard time keeping up with oil production. What they produce is mostly to meet their domestic demand. The US, on the other hand, is trying to invest in oil exploration in Russian states, but is facing serious problems. Chevron Oil Company had signed a forty-year contract with two states in Russia; Kazahkstan and Turkmenistan for oil explorations rights. It has become apparent that these explorations are neither cost effective nor profitable despite oil abundance in these states.[14] In South

America, the oil is hardly sufficient to cover the continent's demands, especially when the United States buys a portion of that oil[15].

This situation of unbalanced oil distribution will create a higher demand on the oil in the Arabian Gulf by the year 2005.[16] Consequently, as oil reserves will be depleted everywhere else, it will become a scarce necessity and oil prices will rise. This will slow economic growth in the industrial nations and cause a recession. What is more significant is, the likelihood of serious struggle tacking place among nations over this vital resource. As the dangers of oil interruption increase, major industrial nations will become more vulnerable which gives them enough reason to worry and plan to abandon oil well before it is exhausted.

Another important reason for the industrial nations to abandon oil energy is for cleaner types of energy. According to scientific studies, the atmosphere is seriously deteriorating from the emission of carbon dioxide. Unburned gases, from different transportation vehicles, are the major cause for this deterioration. Global warming caused by the greenhouse effect and the destruction of the ozone layer will increase the average temperature on surface of the earth about 3C degrees by the year 2100. Oceans, seas and rivers overflow the land. Desertification will increase and life on earth will be threatened seriously unless this problem is controlled very soon.[17] Logically, man would not accept this situation to deteriorate even to a third of that. The average temperature is expected to rise about 1C degree by the year 2020. In 1987 representatives from forty-nine nations at a conference in Montreal called for 50 percent reduction in harmful gases.[18]

The UN set up a formal body in 1988 to report on the risks of global warming. The Intergovernmental Panel on Climate Change (IPCC) has called upon nations to halt rise in

emission of green house gases, primarily carbon dioxide from burning fossil fuel. According to a report by the panel they said, "The world has warmed by around 0.5C degree in the past century."[19] In other reports, the green house gas carbon dioxide has increased 13 percent in 34 years, which is extremely significant. What is more alarming is that they expect about 20 percent rise in the coming decade. This means by the year 2005 the total increase will amount to 33 percent. At present, Europe and North America are producing 50 percent of the global emission. It is worth noting that the concentration of the greenhouse gases continues to increase in the atmosphere 20 years after emissions stopped. In all cases, these harmful gases continue to exist in the atmosphere for an average of one 100 years. The only remedy to this situation seems to be to stop the emission by 100 percent, "These facts, and the growing body of scientific data on the threat to the ozone layer, are prompting nations to consider a 100 percent reduction in CFC production by the year 2000."[20]

Signatory nations to the Climate Change Convention at the Earth Summit in Rio in 1992 agreed to stabilize emissions at 1990 levels by the year 2000. In March 1995, the convention was held in Berlin for its first formal meeting. Many signatory nations, mainly world leaders in CO_2 emission, failed to meet their targets. The only three countries that have managed to cut the emission are Russia, Germany and Britain (Table 5). According to one observer, "The world economy has conspired against the convention. Oil prices have remained low, reducing the incentive for saving energy and spurring growth in the global economy."[21]

Table 5. World Leaders in CO_2 Emissions

Country	Set target by convention	Expected emission in 2000
US	Yes	Probable rise
Russia	Yes	Large cut
China	No	Rise > 25%
Japan	Yes	Rise 3%
Germany	Yes	Cut 10%
India	No	Rise > 25%
Britain	Yes	Cut 4-8%
Canada	Yes	Rise
Italy	Yes	Rise
France	Yes	Rise 10%

Source: *New Scientist*, 18 March 95, No. 1969, 4.

One conclusion is that by the year 2005 the world will realize that the only remedy to the situation is to cut emission of CO2 completely. This will require industrial nations to stop burning oil and start using cleaner substitutes. In addition to the fact that, "By 2025 U.S. petroleum fields will have been pumped nearly dry, and 88 percent of the world's original reserve of oil will have been depleted. Since oil and gas now account for about 75 percent of U.S. economy, the economic structure built around the mix should be substantially different."[22]

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Chapter 3

The Oil Energy Strategy

The oil energy strategy is a rather intricate one, nevertheless I will try to draw a general road map for the possible routes this strategy might travel in the future. Realistically speaking, I can say that nations of the world, particularly the industrial ones, are in a difficult situation. The world is faced with the reality of having to abandon oil for other sources of energy, but does not wish to do so because of the numerous disadvantages. On the other hand, the continued use of oil is presenting serious problems, and as time goes by these problems grow bigger. An unbalanced distribution of oil reserves around the world, along with threats to the environment, produces problems that increase daily. Should industrial nations choose to adopt any energy solution for replacing oil, they will initially face the same set of difficulties until the transfer is successful.

In about ten years, unless a substitute for oil is found, oil reserves will become concentrated in few locations around the world, mainly in the Arabian Gulf region. As a result, the demand for oil will increase and oil prices will rise. This, obviously, will reduce the oil energy profit ratio. Actually over the past twenty years, this ratio has already dropped from 23 to 6.[1] After the year 2005, one dollar will only buy enough oil energy to run existing industries and services without leaving much of a surplus of energy for expansion or research and development. Thus, economic growth will slow down and

may stagnate. Another serious consequence from unbalanced oil reserves is an increase in disputes, conflicts, and struggles among nations. A few powerful industrial nations will attempt to control locations of oil reserves in order to secure their future. The Gulf War is merely an example of the kind of struggles that will prevail in an attempt to assert control in the region. For this purpose, the possibility of conflicts among industrial nations is real in the future. Obviously, if the rivals were more compatible militarily, the fighting would be fiercer and the war would last longer.

Degradation of the environment from burning oil is becoming worse by the year. Although industrial nations have agreed to cut emissions of CO_2, they have not met their commitments. On the contrary, low oil prices are encouraging them to burn more oil and increase their emissions of CO_2 into the atmosphere. There is no forecast of the impact from such a situation, but it can be fatal. Survival on earth is paramount, but as the effect of global warming becomes worse, the world will have no choice but to stop emission altogether. This means transportation, industries, and services will have to come to a halt. If this happens before the energy substitutes are readily available, then the world will go back to the dark ages. However, if the world continues to pump CO_2 into the atmosphere, the surface of the earth will begin to disappear under water and human life will be seriously threatened. Before I start discussing the strategy, this section discusses future energy options the world will adopt, presents contemporary evidence of successful efforts to replace oil energy with other substitutes, presents an overview on the past and present strategy, particularly of the United States strategy to access oil around the globe, speculates on the strategy during the transition from using oil to alternative sources of energy, and also after the transition has been completed.

Technologically advanced nations, such as the United States and Western Europe, are conducting research to develop energy substitutes to oil. Today they have the luxury to do so because of the energy surplus that oil provides. But, with time this surplus of energy will reduce drastically because the energy profit ratio will drop. Actually, the energy profit ratio is a detrimental factor towards adopting any solution. As mentioned earlier, the hard path solution includes all the nonrenewable energy sources such as oil, gas, coal, oil shale, sand tar, coal liquefaction, geo-pressured gas, and nuclear fission. At first glance, it seem ridiculous to worry about the fate of energy in the future, specially that, "oil shale, coal and other hydrocarbon deposits in the United States alone are far greater then the petroleum reserves of all the Middle East." However, scientific research indicates that extracting energy from these sources, in many cases requires more energy than they contain. Except for oil and gas, all other non renewable sources have a fairly low energy profit ratio, and "hard path fuels besides solid coal will probably have an average profit ratio over their life time of no more than 5, which is low by current standard."[2] A more realistic estimate puts the energy profit ratio for the hard path to "perhaps 2.5."[3] Today however, we must realize that all hydrocarbon fuels degrade the environment and cause serious pollution. Consequently, a lot of energy will have to be spent on cleaning up the air. Also, "reclaiming the land destroyed by strip mining"[4] requires extra expenditure of energy, and reduces even further the energy profit ratio for nonrenewable sources.

Nuclear energy both from existing technology and from future developments has a rather low energy profit ratio. The problem with nuclear energy is that, reactors require huge amounts of energy to construct them, maintain them, and finally dispose of them at

the end of their life cycle. Actually, the energy profit ratio of nuclear power is "no greater than 3.4 over the life time of all plants now on line and under construction."[5] The evidence to this is that more plants are being decommissioned than built.[6] Also, "Utilities are finding that the costs of dismantling a nuclear plant are sometimes greater than those of building the plant in the first place."[7] While coal is the primary source for electricity in the United States, it becomes expensive once we have to clean up the environment. "Coal puts 2.4 billion tons of carbon into the atmosphere worldwide."[8] With this it becomes obvious, the hard path is not a very promising solution. After all, the energy sources from it cause serious destruction to the environment. The question is, will the world choose the hard path? Maybe, but at a very high price. The fact remains I could not find solid evidence to prove the world will go down this path in the future.

On the other hand, most recent evidence indicates that the world will adopt the soft path solution. Research and development are materializing into inventions that have proven success, but thus suggesting that a technological breakthrough maybe on the horizon. After all, the soft path is the solution to both future crises. This solution depends on energy sources that are renewable and infinite such as solar, wind energy, and water power, but these sources are available everywhere. The problem of unbalanced distribution of reserves will not exist any more. Moreover, the energy sources of the soft path dose not impose a threat to the environment. Like the hard path, the soft path has a rather low energy profit ratio, but the advantages over the hard path are with no doubt numerous. Logically, industrial nations will invest in developing energy sources that are renewable, instead of risking huge amounts of energy to develop energy sources that cost about the same but present the risks of being exhausted. Moreover, the investment in the

soft path fuels would pay off in the long run because the environment has to be cleaned up, and it will take centuries to undo the harm inflicted upon it.

Recently, reports on several successful inventions have demonstrated that the world is exclusively embracing the soft path solution. For example, the United States and Norway have produced an electric car for urban transportation. In the Year 2020 about 80 percent of urban transportation in California will use similar type of transportation. This car is already available in the markets in California and Europe[9]. Another example is that an important technological breakthrough in transportation will render oil completely ineffective in the future. Recently, a car the size of a Volkswagen and the power of an eight cylinder was invented in Germany. This car does not depend on oil energy and the amount of environmental pollution it causes is equivalent to a bicycle. This technology depends on fuel cells, which use water to produce electric energy. It is also environmentally friendly. The products from operating these types of engines are water vapor, electricity and heat, but not CO_2. This technology is expected to be fully developed in two years time. Today, buses are already on the roads in several countries around Europe for experimental purposes. They can top a maximum speed of 60 miles per hour and the range is about 100-150 miles before they need to refuel.[10]

As the world continues to use oil for some years to come, in the meantime car manufacturers will seek to develop engines that can save large amounts of fuel. In the long run, however, conserving or saving fuel does not ultimately solve the problem. One report suggested that a person from California invented an engine that is extremely cost effective. The engine has an electromagnetic valve actuator that controls the fuel intake valve speed, while present engines operate with a constant valve speed. The new

technology reduces fuel consumption by about 30 percent and provides 10 percent more power. Car manufacturers in the United States will incorporate this enhancement in the 1998 car models. The engine will include a device that burns the fuel completely in order to reduce CO_2 emission.[11]

There are significant technological breakthroughs in the field of superconductors. One firm has produced superconducting cables for commercial use. These cables will reduce electric bills dramatically, because unlike the traditional cables they do not provide any resistance while the electric current passes through. The problem of supercooling a wire to -300F has been solved by insulating the wire and trapping nitrogen gas around the wire. The South Wire Company is one of the largest of its kind in the United States, it produces 1/3 of all U.S. wires and cables for different uses. Initially, to produce the new cables the company will incur high costs, for this reason the United States government will support this program because it believes this is the future forward. In my opinion, these kinds of cables are critical for future success of solar and wind energy in providing electricity at a reasonable cost. In the field of aviation, NASA has recently launched the first solar powered experimental aircraft. The aircraft has flown up to an altitude of 56,000 feet, much higher than the top of the clouds, and at a rate of climb 23-24 feet per second. The speed of the aircraft at sea level is 20 knots, but at 65,000 feet the speed is 65 knots. The aircraft is built from a lightweight fiber composite material powered with six motors. Solar energy is absorbed over the top of the wings, and the aircraft can fly during dark hours with the reserve energy stored by a device called energy stopper. According to the report, the prospects of developing an aircraft that can transport passengers in the future are excellent.[12]

These examples and many others indicate that the world is actively working to find alternatives to oil energy, they also indicate that these alternatives consist of the soft path solution. Until these alternatives are completely developed, oil remains extremely vital to the world.

Since its discovery, oil has been crucial to the world, particularly to industrial nations. The importance of oil to prosperity and modern life is as vital as water to human life. During war, depriving the enemy of this vital source is the means to victory. World War II illustrates an excellent example, as the allied forces strangled Germany and deprived the German military forces and the industry from oil. The Axis strategy during WWII, depended largely on occupying areas and locations that contained vital resources they needed to insure their survival and prosperity. This indicates that, "The history of grand strategy is to a remarkable extent the history of resources access and denial. . . . Resources, in this instance, can be defined as the totality material means a state requires to assure its continued existence and prosperity. Oil is a prominent example, unique with regard to its persuasiveness in civilian economies and its introduction as a naval fuel 80 years ago."[13]

The idea of access and denial revolves around the use of force. For this purpose, military force presents an excellent tool a nation can use to negate the enemy the vital resources they need. On the other hand, the need to access that resource also may require the need to fight. Nations have adopted one of two main approaches to obtain vital resources that exist in other parts of the world. The first approach considers the absence of the vital resource to be a vulnerability. With this in mind, this approach depends on the need to secure the resources at their location by occupying that location and then

transferring the resources to the heart of the nation over land. The second approach suggests that the vital resource is an economic asset and the means to strength and power. The method to secure the resource is to protect that location and insure an open sea line of communication for the transfer of the resources. In this case occupying the location is not required, but maintaining a strong naval fleet is mandatory.

These two approaches are, "Two competing traditions, the autarkic-continental and the liberal-maritime, have been central to shaping of grand strategic thought and practice. These two approaches to strategy differ from each other in that the former views the system of international trade and communication as a vulnerability, while the latter views it as an asset; the former's strategy of access to resources is continental, the latter's is maritime; and the former's impetus for action is active geopolitics with revisionist aim, the latter is the defense of vital interest sphere."[14] In pursuit of economic security, the structure of the United States grand strategy was always based on a liberal maritime approach. After the second oil crisis, the United States demonstrated more reliance upon this approach very firmly. In 1980, President Carter ordered the formation of a rapid deployment forces to protect oil flow from the Arabian Gulf region. This action was based upon the Carter Doctrine: "An Attempt by any outside force to gain control of the Persian Gulf region will be regarded as an assault on the vital interests of the United States of America and such an assault will be repelled by any means necessary, including military force."[15] Since that time and during any oil crises, the United States continues to apply this approach very actively. "The coalition approach to security in the Gulf has characterized U.S. strategy from the Carter Doctrine through operation Desert Storm is

solidly within the Anglo-American liberal-maritime tradition access to economically vital areas."[16]

In the past, threats to the interruption of oil portrayed industrial nations as vulnerable, thus sharing the continental approach their views. However, the extent of these threats was reasonably controlled, and the vulnerability was an accepted fact of life. "The perception of economic vulnerability also plays a part in liberal-maritime tradition, but here it is a very much accepted vulnerability."[17] Also, "The underlying perception about the vulnerability of industrial economies to interruptions in vital trade were not very different from those that might motivate a regional power in the Persian Gulf to threat in a closure of the Straits of Hormuz or the destruction of critical oil facilities in a crisis. The tanker war is an example."[18] As time goes by, when the oil reserves becomes seriously unbalanced, or rather concentrated in the Gulf region, the vulnerability will become unacceptable. A scarce vital resource needed by all nations invites serious competition among them because it becomes an imperative to control the location of reserves in order to maintain power and avoid being vulnerable.

At that time, efforts to replace oil will accelerate, but until such time this process is completed conflicts and struggles among industrial or powerful nations will be on the rise. The struggle might be a West-West (e.g., The United States against Europe) or an East-West struggle (e.g., Eastern Asia including Japan and China against the United States and Europe). With the theory of realism in mind, harmonious relations between nations based on mutual interests might end up in conflict. Until the year 2005, the world will continue to enjoy what seems to be the golden era of the oil age. As the tension from the Cold War is over and the dust from the Middle East conflict seams to settle down,

low oil prices will spur global economy for a while. The world will be unaware of the dangers of the future.

Actually, low oil prices aggravate the situation and encourage industrial nations to consume more oil in order to improve production and to achieve highest economical growth possible. This, in itself, will make the success of developing energy substitutes lag behind the depletion of oil. In my estimate, the unbalanced oil reserves, will begin to affect the world by the year 2005. At that time, the world will firmly decide to replace oil energy with other sources. By then, the transition period to alternative energy sources will begin, but will not be complete until the year 2025. Since the average life cycle of a car is ten years, an aircraft is twenty years and a ship is thirty years, it will take average twenty years to replace these products with the new technology that runs on alternative energy sources. Thus, the world will continue utilizing old products until the year 2025 to get back their manufacturing cost. During the transition period, the new technology will gradually replace the older one, most certainly industrial nations would complete the process by the year 2025.

The transition period will witness an economic stagnation, and maybe a depression. During this period, the world will produce products just to endure the wave of change. Nations will continue to use oil and gas mainly to run essential industries, however, the surplus of energy will be diverted for developing energy substitutes. Obviously, oil will become extremely vital for industrial and powerful nations. A liberal-maritime strategy will no longer serve the national objectives of those nations. Vulnerabilities which were accepted by a liberal-maritime approach in the past will be utterly unacceptable in the future. The only way to access the resources and to deny it to the competitors is to revert

to an autarkic-continental strategy. A military presence over and around oil locations will become essential. History will repeat itself as much of the circumstances lead the world to a global struggle and perhaps another global war.

At present, regional hegemonies in the Gulf region threatens accessibility to the oil and this situation becomes worse when oil reserves become completely unbalanced in the future. In his statement president Bush clearly expressed the United States position in 1990, "Vital economic interests are at risk. . . . An Iraq permitted to swallow Kuwait would have the economic and military power, as well as the arrogance, to intimidate and coerce its neighbors-neighbors who control the lion's share of the world's remaining oil reserves. We cannot permit a resource so vital to be dominated by one so ruthless."[19] Three years after the Gulf War, Iraq once again mobilized huge military forces towards Kuwait in the summer of 1994. In response to this, the United States augmented forces to prevent another Iraqi invasion, this became known operation "Vigilant Warrior."[20] This indicates clearly that "viewing a renewed Iraqi threat to Kuwait and Saudi Arabia as unacceptable."[21] Neither Iraq nor Iran will be allowed to threaten the flow of oil to the world in the future. Thus, a liberal-maritime approach is not suitable to deal with these threats. Actually, The Gulf War offered a golden opportunity for the United States to revert to an autarkic-continental approach. Today, we can observe a constant U.S. military build up in the Gulf States. According to a prominent political scientist, "Whoever controls world resources controls the world in a way that mere occupation of territory cannot match."

Based upon the Carter doctrine, and as vulnerabilities became more serious, the United States government activated Central Command on 1 January 1983. It believed, "It

met the requirement for a major theater command to serve U.S. interests in Southwest Asia and the Persian/Arabian region. Tension in the area began to heighten in the late 1960s and early 1970s following Great Britain's withdrawal from east Suez. The Iran revolution of 1979 and Soviet invasion of Afghanistan in 1979-80 changed the balance of power which clearly addressed the need for counter-balancing force to maintain regional stability."[22] Essentially the mission of CENTCOM is to "put military capability behind national commitments to the region by preserving and protecting access to oil supplies of the Persian Gulf."[23]

After the Gulf war, the United States pre-positioned military equipment and armament in different Gulf states and after operation Vigilant Warrior the forces had to be increased. Those forces include, "heavy brigade set of equipment in Kuwait. At the same time, efforts are progressing on placing a second brigade set with division support equipment in another Gulf state as well as on exploring the possibility of positioning a third on the ground elsewhere in the region. With heavy division set of equipment positioned ashore, CENTCOM would enjoy improved operational flexibility to deal with full range of threats and correspondingly strengthen the deterrent effect of forward presence."[24] At this rate, the build up of forces in the year 2005 would reach several divisions and would continue to increase as the oil reserves become more concentrated. The fact remains, the United States forms 5 percent of the world population, but consumes 28 percent of the world energy.[25] Today it enjoys a high standard of living as oil provides prosperity and security. The question remains, will the United States compromise standards of living or security during the energy transition period? Sure enough, the U.S. will be ready to fight any rival coming to the region during this period.

There is no doubt that in 30 years the world will stop using oil as a source of energy. Industrial and advanced nations will enjoy the advantage of obtaining other sources of energy with advanced technology. They will not face hassles and the worries of obtaining oil for survival. The burdens of securing it with military force will disappear, and thus access and denial will be a game of the past. If new sources of energy will offer a lower energy profit ratio, the production of goods, food or to run the transportation and provide services will be at a higher cost. It will be very costly to maintain a large and advanced military force. Standards of living in the advanced world will drop and the situation in the developing world the will be worse. Industrial nations with the advanced technology while are able to obtain new sources of energy will be considered the "have nations." Developing nations on the other hand, which have less to offer to the advanced nations, will not be able to afford the new technology and they will be considered the have-nots nations.

The real question is: what strategy after the oil . . . in the 21st century? If a major war happens during the transition period, it will result in reshaping relations among nations of the world. Globally, it will create a North-South struggle between the haves and the have nots. Advanced nations will not have much incentive to engage in the developing world. The United States, for example, will change its strategy from "Engagement and Enlargement" to "Protection and Contraction." Simply, this means the United States will protect what it has and will pull away from its world commitments. It will restrict its trade with wealthy and industrial nations only. It will also reduce its military expenditure and its presence around the world. Other industrial and advanced nations will follow a similar path. Developing nations will fall far behind advanced

nations, and the gap between the first world and the third world will widen. Also, developing nations will struggle to obtain what advanced nations have. Nations will be confined to their territories and migration will be limited. Finally, this is the future and this is the problem, what can we do about it, this is the question.

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