1990

U.S. energy policy under the Reagan Administration

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U.S. ENERGY POLICY UNDER THE REAGAN ADMINISTRATION

A Thesis
Presented to
The Faculty of the Department of Political Science
San Jose State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Kevin L. Murray

March 1990

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ABSTRACT

U.S. ENERGY POLICY UNDER THE REAGAN ADMINISTRATION

by

Kevin L. Murray

The purpose of this thesis is to present a critical analysis on the Reagan Administration's energy policy. To achieve this purpose, this thesis is designed to review and discuss the *National Energy Policy Act*, an annual publication required by law that outlines an Administration's energy policy agenda. The specific policy goals and implementation strategies of the Reagan Administration energy program are evaluated and contrasted with plausible options and alternative energy policies.

The results of this investigation indicate a general agreement on the goal to achieve a stable and plentiful energy resource environment. However, the means to realize this energy resource environment, and the resulting energy technologies promoted by the federal government, differ greatly based on whether energy development and use should be viewed narrowly as a commodity or a public resource possessing strategic and environmental policy implications.

TABLE OF CONTENTS

INTRODUCTION.....	1
Energy Crisis: Superpower Ramifications	1
The Creation of U.S. Vulnerability and Plausible Solutions.....	2
SECTION I -- THE REAGAN ADMINISTRATION ENERGY POLICY	9
The Existing Structure: Pre-Reagan and Post-Embargo	9
The New Goals.....	11
The National Energy Policy Plan	15
Energy Stability	15
Energy Security	20
Emergency preparedness	20
International energy security.....	23
Research and development.....	25
Domestic production	26
Efficiency in energy use.....	26
Energy Strength	28
Oil and natural gas	28
Coal.....	30
Nuclear	32

Renewable and alternate fuels	33
Summary of the U.S. Energy Policy Under the Reagan Administration...	35
SECTION II--ALTERNATIVES.....	38
Issues at Hand	38
Views of Energy.....	39
Direction of Our Society	40
Business Interest vs. National Security	41
Profit motive and centralized power generation	43
Inefficient use of energy.....	43
Resistance to decentralization and maintenance of energy intensive consumer demand.....	44
Energy suppliers and the risk of anti-U.S. sentiment.....	44
Business Interest vs. National Security -- A Case Example.	46
Proposed Changes.....	49
New View of Energy and the Federal Role.....	49
View of energy as an ecological/strategic resource.....	49
The federal role.....	50
Case by Case Fuel Source Appraisal	51
Oil.....	51
Environmental impact	51
Sustainability.....	55
Geopolitical location	56

National/economic security.....	58
Conclusion	58
Natural gas	61
Environmental impact.....	61
Sustainability.....	62
Geopolitical location	62
National/economic security.....	64
Conclusion	64
Coal.....	65
Environmental impact	65
Sustainability.....	68
Geopolitical location	68
National/economic security.....	69
Conclusion	71
Nuclear	72
Environmental impact	72
Sustainability.....	72
Geopolitical location	75
National/economic security.....	75
Conclusion	76

Solar power	78
Environmental impact	78
Sustainability.....	78
Geopolitical location	78
National/economic security.....	80
Conclusion	80
Geothermal power	81
Environmental impact	81
Sustainability.....	81
Geopolitical location	82
National/economic security.....	84
Conclusion	84
Wind power.....	84
Environmental impact	84
Sustainability.....	85
Geopolitical location	87
National/economic security.....	87
Conclusion	88
Water power	91
Environmental impact.....	91
Sustainability	93
Geopolitical location	103

National/economic security.....	103
Conclusion.....	105
Conservation.....	106
Environmental impact.....	106
Sustainability.....	110
Geopolitical location	113
National/economic security.....	114
Conclusion.....	115
CONCLUSION	123
NOTES	130
Introduction	130
Section I	130
Section II	132
BIBLIOGRAPHY.....	136

Introduction

Energy Crisis: Superpower Ramifications

We should recognize that energy policies are central to the performance of global-political economies.¹ Their success or failure may prevent or cause disruptions in domestic and global economic stability. In fact, irrespective of ideological orientation, every nation's *national security*, *international relations*, and *industrial development* are all related to energy opportunities or constraints. Moreover, the urgency surrounding energy opportunities is fueled by the perception that access to the world's energy supply is a principal vehicle for individual and national greatness, particularly within the Western Democratic camp.²

Given the importance of world energy access to a nation's national security, international relations, and industrial development, it would stand to reason that the more industrially advanced countries would adopt careful strategies to minimize their vulnerability within each policy area. However, in contrast to what logic would suggest, today we live in a world of industrial nation-states largely dependent on finite and unpredictable resources. This condition is a volatile variable in the often fluctuating formula for peaceful coexistence in East-West relations. In the interest of stabilizing and perhaps expanding the mutual tolerance for our seemingly diametrically opposed sociopolitical ideologies, we should avidly pursue and implement every effort to minimize energy struggles that might catalyze an East-West military confrontation. Ideally, this would include formulating a cooperative energy policy with the Soviets that would stabilize superpower relations. However, the separate issue of a cooperative East-West energy policy is beyond the scope of this thesis. Instead, a focus on the past U.S. policy under the Reagan administration will serve to explore one side in the East-West equation of world energy access and use.

The Creation of U.S. Energy Vulnerability and Plausible Solutions

We represent an energy-intensive society. Figure 1 illustrates our uses for energy in the United States.

Figure 1. The Uses for Energy in the United States

Source: *World Resources 1986*. World Resources Institute.

Under the direction of key industrial entrepreneurs and collaborating public decision makers, we have built a life around cheap, abundant energy as the very life blood of America's industrial-technological society.³ For more than two hundred years, the nation's use of energy has doubled every twenty to twenty-five years.⁴ Despite this alarming energy dependent trend, efforts

to construct safeguards against the dependency on imported oil were diluted by the revered rationalization coined as "progress" and motivated by price. The concept of progress--typically measured by industrial production with competitive price inputs--often includes the required trade-off of utilizing excess energy resources at both production and operating phases to meet an output goal. In addition, energy inputs for industrial capacity based solely on price competitiveness may create an unhealthy dependency on a singular resource input: a condition of operating in the short-term "business quarterly" style, which is irresponsible with respect to long-term planning designed to preserve future national and international energy policy options. These relationships--progress measured by production capacity and the price competitiveness determining the source of our energy inputs--should be termed relative progress. Alternatively, real progress is not realized unless energy efficiency standards are applied to both production and operation phases. Second, price alone should not dictate the course of our national energy inputs without accounting for the potential ramifications for the following:

- Our national security
- Our allies' national security
- The impact upon the environment
- The present and future projected quantities of the fuel resource

As our process of steady industrialization consumed larger quantities of energy for industrial applications (primary metals, chemicals, food, paper, stone, glass, clay, coal, etc.) and produced luxury items that progressively shifted to necessity items (private vehicles, refrigerators, water heaters, home appliances, street lights, televisions, heating and air conditioning, etc.), our entire economy proportionally continued to increase its dependency on cheap electricity, natural gas, coal, and oil. This energy-intensive trend--among a handful of energy resources--has produced a condition of highly centralized suppliers with increasing consumer dependency. Table 1 provides a synopsis of the principal characteristics of the current U.S. participants in today's conventional fuel uses as regards their ownership, management, labor politics, government interface, and which regulatory agency they fall under.

Table 1. Principal Characteristics of U.S. Participants in Conventional Fuel Uses

	Coal	Oil	Electricity	Natural Gas	Nuclear Fuel
Industry Associations Ownership	NCA Oil firms own much production	API, NPC Vertical horizontal, integration of majors	EEI, EPRI Both public-owned and investor-owned firms	AGA, API Close ties to oil producers, but also transmission, distribution firms	None Public monopoly until recently
Politics	Poorest energy industry, low profile	Richest energy industry—heavy lobbying and campaign aid	Limited, but increasing lobbying	Complexity limits community of interest	Dominated by scientists, atomic energy experts
Labor Membership	UMW, 115,000	OCAW, 200,000	No labor union that is indigenous to electricity	Same as oil industry	Same as oil, gas industries
Politics	Strongest energy union—conflict with IUOE	Weak history of unionization			
Government Public—private interface	Least subject to federal control—history of state control	Heavily regulated at federal, state levels	Major state role	Major state role	Most subject to federal control
Regulatory agencies	Interior Department (MESA)	FEA, DOI	FPC	FPC	NRC

Source: Don E. Kans and Robert W. Rycroft, *U.S. Energy Policy: Crisis and Complacency* (Norman: University of Oklahoma Press, 1984).

If this energy dependency had been chiefly supplied by our domestic centralized suppliers, then the relative threat to our national security would not be what it is today. However, the gap between consumption and domestic supply was filled by low-cost imported petroleum. By 1973, we found ourselves dependent on foreign sources of oil to the tune of six million barrels per day.⁵

We have arrived at a precarious state of national vulnerability on many fronts. First, there is the problem of our continuing reliance on imported energy resources from highly unpredictable and potentially hostile suppliers. Second, because the expanding consumption of energy resources is perceived as imperative for economic viability, we have largely accepted and witnessed the growth of a centralized and wasteful energy system. This has inhibited renewable and decentralized energy options for the American consumer. Third, the present day U.S. energy policy is a regression to the pre-1973 agenda--an era that regarded energy resources as commodities, subject to the demand of the marketplace for both short- and long-term developments. Until we create policies that appropriately respond to our oil dependency in the Middle East and our sheer weight of global energy consumption, the luxury of categorizing energy as a commodity is over.

Today, energy must be regarded as a public resource requiring significant public policies that enjoy high levels of public consensus and support if we are to prepare adequately for and respond to its influence on our economy, national security, and lifestyle. Our precarious economic and lifestyle dependency on today's conventional finite resources has made energy use and development too basic an input to be surrendered to the interests of presumed apolitical corporate managers within the US energy industry. Ironically, their success in marketing a monopoly industry has achieved the unacceptable scope of corporate energy decision makers' determining the future of society, especially in view of the fact that their overriding economic imperative has played a significant role in current national vulnerability.

Ultimately, we may achieve a return to a stable energy system, yielding both an energy surplus and lower existing rates of environmental pollution. On the aggregate, let us hope that we strive to construct policies to produce a new energy-mix with the intent to circumvent East-West tensions by being able to stabilize our respective domestic and ally energy requirements for economic prosperity.

Our country's energy dilemma is faced with a dual goal. First, we must *decrease our foreign energy dependency*. This objective can only be realized by our second interrelated goal: *increase efficiency in our current level of energy use while simultaneously developing "substitution" resources*. The depth and breadth of governmental energy efficiency programs and the selection and promotion of substitution resources represent two fundamental differences between the Reagan Administration's approach to energy policy as compared with supporters of "alternative" fuel resources. Under the Reagan Administration, the scope of energy efficient legislation is often watered down or vetoed because of what predictably is characterized as undue federal governmental intrusion into the marketplace. For example, the National Appliance Energy Conservation Act of 1986, which would have established minimum energy efficiency standards for home appliances was vetoed by President Reagan. The reason: the act intruded unduly on the free market and constituted a substantial intrusion into traditional state responsibilities and prerogatives.⁶ The rationale to veto this conservation act fails to understand the dynamics of energy policy with respect to national and international public policy ramifications. First, if a minimum energy efficiency standard for home appliances were applied nationwide, then marketplace principles would be satisfied: those appliances with the most economical price would still be favored by consumers because market conditions would be preserved by prohibiting the sale of appliances that fail to meet energy efficiency standards. Second, the right of each state to develop legislation unique to its regional make-up is not being grossly challenged with respect to home appliances. Inefficiency can be described as one state developing a progressive conservation history that is usurped by another state's comparative lack of participation in a "national" effort for energy conservation. In effect, any one state's accomplishment in energy conservation can be canceled by a neighboring state's *prerogative* to prohibit energy efficient legislation. After all, any state able to remain exempt from a national trend to produce and use more energy efficient products will enjoy an economic advantage by producing cheaper price-per-unit consumer goods because producers will not be required to invest in energy efficient components. In essence, energy policies require a strong *national agenda* to supersede the possible parochial economic interest of a single state that--on an aggregate-- can adversely affect national progress in conservation and remove a sense of shared state responsibilities within the unique national issue of energy acquisition, use, and development.

As this thesis will demonstrate--in addition to policy directives that are counterproductive to energy efficiency goals--federal monies to promote alternative resource also found far less favor with the Reagan Administration. Instead, the Reagan energy policy focused on nonrenewable domestic and international resources until exhausting their price competitiveness before large-scale structural substitution resources were developed and instituted. The principal nonrenewable resources include oil, coal, natural gas, and nuclear. Alternatively, renewable resources (wind, solar, water, biomass, and geothermal) are far more environmentally benign and offer an added bonus by decentralizing the energy industries' command on the conversion of raw resources for consumer consumption. Except for the initial investment in renewable technologies, the fuel source itself is often self-delivered and unlimited. These advantages should be self evident. However, capitalizing on renewable energies will require structural changes in the way we as a nation use and regard energy.

First and foremost, for any changes to occur over the next two decades, significant federal, state, county, and local consumer financial incentives will have to be implemented. The American consumer is, for the most part, a pocketbook voter. To ignore this obvious precept is to ignore what has traditionally brought the Pilgrims and contemporary refugees to these shores: namely, access to upward mobility. This requires the capacity to save and invest money. Unfortunately, the nation must recognize that--for the first time in our history--the current 18 to 45 year-old generation is experiencing the task of "maintaining" the socioeconomic environment he or she was born into. This is a significant change from the notion of a springboard effect to the next socioeconomic strata given an individual's background. Consequently, the traditional importance given to the concept of being a thrifty individual--for purposes of managing one's life's direction--is an even more acute concern today; therefore, the capacity to motivate behavior--based on today's economics and hence slim saving power--is proportionally a greater tool that may affect more numbers in a shorter time. Therefore, legislation to promote energy conservation based on clear economic benefits t presents excellent promise for nation-wide conservation participation. Alternatively, the absence of financial incentives for renewable resources will likely be reflected in the expansion of the nuclear industry via the breeder reactor combined with the increased harvesting of

available nonrenewable domestic resources. This approach will not address the source of the problem but rather may guide the next evolution of centralized fuel demand from wood to coal, coal to oil, and now oil to nuclear power. Ultimately, the needed structural change affecting our energy use will require that "we be able to act with a kind of purpose and determination that, in our system, requires a very broad consensus."⁷ As a result of the Reagan Administration's energy policies, this emerging consensus between 1973 to 1980 was largely disbanded. The use of federal regulatory and fiscal incentives to create a multiplicity of energy options for all Americans has been systematically dissolved. There is still hope.

The following study consists of two sections. Section I--The Reagan Administration Energy Policy--will address the existing U.S. energy policy and, based on this investigation, qualifies these past approaches as counterproductive for the progress and security of the American society.

Section II--Alternatives--will examine options to the past Reagan energy policies in the hope of demonstrating the need and available avenues to achieve innovative and viable energy programs not presently recognized by those in a position to make change. Also note, these options remain applicable to the current Bush Administration given his near mirror energy agenda.

Section I

The Reagan Administration Energy Policy

The Existing Structure: Pre-Reagan and Post-Embargo

When the 1973-74 Oil Embargo reduced some of the nation's oil imports, it became clear that the existing energy policy did not possess the capacity to activate tradeoffs among conventional fuels to meet short-term demand, nor had it been developing new sources of supply.¹

The new facts of energy rendered existing fuel policies and policy making systems obsolete.² The changed facts of energy demonstrated three conditions all of which carried elements of uncertainty:

- Oil and gas are finite resources.
- Imported oil is drawn from unpredictable and possibly hostile sources.
- Nuclear energy and coal alternatives possess environmental and cost concerns.³

In response to America's sudden energy vulnerability, an energy-community began to emerge for purposes of formulating new energy policies relevant to the changed facts of energy. This energy policy community consisted of departments within the federal and state governments, the private sector, nonprofit research organizations, and energy interest groups. From this collection of policy analyses, a consensus began to form recognizing that energy policy required a system that could manage and integrate several existing and potential energy sources. In order to promote a broad base of commitment, policy decisions would be derived from a problem-solving and a consensus decision-making process.⁴

President Carter proposed solving the energy dilemma through a government that accepted responsibility for dealing with the crisis comprehensively and by a public that

understood its seriousness and was ready to make necessary sacrifices.⁵ With this view in mind, the essential parts of a stable energy policy system had been forged. These new adjustments included:⁶

- The pre-1973 energy goals of abundance, cleanliness, and security were redefined to consistent with the new facts of energy.
- Conservation and synfuels were moving into the category of available resources.
- Federal research and development for potential and theoretically possible energy resources were in operation.
- Congress had moved in the direction of using federal subsidies as energy incentives instead of the use of sanctions.

The nation's new energy plans were designed to respond to the immediate fossil fuel demand while investing time and revenues for long-term substitution resources. By contrast, the Reagan Administration argued that the expanded role of the federal government was misguided and counter productive.⁷ Energy policy made an abrupt shift to a reliance on marketplace mechanism guided by the new president's program for economic recovery.⁸ The insight of energy policy requiring special attention was displaced by the resurrection of the pre-1973 energy policy approach; that is, one simply motivated by profit and access to resources.

The new administration would reduce the energy role of the federal government to two primary tasks: the leasing of federal lands for expanding the production of coal, oil, and natural gas and support for the nuclear breeder reactor (federal).⁹

More generally, the Administration's dismantling of the energy-policy community reinforced four energy themes from 1981 until the present:

- The primary responsibility for energy policy is entrusted to the marketplace exclusively, except for federal fiscal favor involving the breeder

reactor and long-range research and development of high energy physics.

- Environmental protection was downgraded across the board.
- Energy abundance is the acceleration of federal lands open to energy developers described as the private sector.
- Energy security, in both short-term and long-term circumstances, could be achieved via the marketplace.

To demonstrate these shifts and understand the rationale behind them, a review of the Reagan Administration policy goals is required.

The New Goals

To understand the Reagan Administration's national energy policy (and its prevalent orientation via the Bush Administration) is to recognize the Administration's economic philosophy as applied to the energy field. In fact, the Reagan approach is a radical departure from the prevailing policy instituted after the first shock of rapid oil price increases in 1973 and 1974. The government is redefined as the real culprit in the energy crisis and the "marketplace" as the solution.¹⁰ Energy is described as a commodity and like other commodities, its direction will be derived from the forces of the marketplace. The summation of the Administration's position, given in the *Bureau of National Affairs* (1981, page 1115), clearly illuminates this new marketplace approach:

The one thing certain about the future is that the exact path of energy development and market is uncertain. Technological innovation, geological discoveries, changes in the economy at home or abroad, political or military conflict, and variations in public attitude are all inherently unpredictable events that can alter the nation's energy situation drastically. Under the free market philosophy of this Administration, the American people themselves will actually conduct a continuing national plebiscite in the marketplace to express their individual and collective evaluation of possible courses of action. Their actions will determine ultimately whether energy consumption per capita in this country

risers or falls between now and the year 2000 and what our mix of energy sources will be at the turn of the century.

Clearly an energy policy designed simply to respond to unpredictable economic forces fails to produce an effective scheme to enhance U.S. domestic energy stability and by extension, East-West global energy predictability of supply. In contrast, there should be a planned policy influencing economic incentives in the production and consumption of a variety of energy sources. Interestingly enough, in the absence of a planned policy--as this investigation reveals--nuclear fission and fusion energy programs enjoy a disproportionate amount of federal financial favor. In addition, we have witnessed increased federal efforts to open up domestic offshore drilling tracts. This should not be too surprising as a simplistic marketplace approach can only respond to the supply and demand of the predominate centralized energy facilities available to the majority of American consumers--obviously, we speak of fossil fuels. Therefore, this marketplace approach is not designed to develop diversified energy choices to the consumer but instead, by design or outcome, will reinforce existing fossil fuel dependency as a consequence of not altering the structure(s) of energy consumption habits or services. And since the source of the problem is not affected (singular energy source dependency), the solution is not appropriate save paving the way for justification for increased offshore domestic oil drilling and setting the stage for the next phase of centralized energy: fossil fuels to nuclear.

As the nebulousness of the free market philosophy began to translate into policy, a collection of previously sanctioned renewable energy resources underwent a change in priority. Among these changes, a three-fold pattern emerged:

First, there was a shift to reduce foreign energy consumption by removing limitations in domestic production of conventional energy sources; namely, nuclear and fossil fuels.

Second, the research for renewable resources (solar, wind, biomass, geothermal, current, co-generation) was largely usurped in priority through funding cuts and displacing capital incentive to participate.

Third, the focus on conservation (which in itself should be regarded as an energy source) was neutralized by the reappropriation of financial resources to the conventional energy camp.¹¹

The following figure best illustrates energy funding changes between the Carter and Reagan Administrations.

Figure 2. Energy Funding Changes between the Carter and Reagan Administrations
Source: *Friends of the Earth*, 1982.

In short, an energy policy limited by a free-market ideology will not promote individual preferences or more efficient resource utilization. Instead, such orientations reinforce the power of decision making within the energy establishment who dominate the factors of production. Authors Kash and Rycroft (*U.S. Energy Policy: Crisis and Complacency*, p. 18) cite a fellow energy scholar who notes:

In theory, the market approach maximizes individual preferences, but such choice maximization and resource utilization efficiencies are a function of the organization of energy suppliers and the public's perception of the nature of the good being

If competitive markets existed in all fuel areas and few opportunity costs were associated with switching from one fuel to another, then such a basis for energy organization might be viable. However, producers and distributors of principles may not strictly apply. Also, fuels and electricity may not be considered to be private goods subject to disposition and consumption through the exercise of private preferences. Society perceives values other than British Thermal Units and kilowatts associated with energy decision making. This fact is evident in the numerous social and environmental issues raised in relation to the making of energy policy decisions.

Despite these findings, the Reagan presidency focused on the ability of the free market to reflect the nation's highly complex, pluralistic society through an economic choice mechanism.¹² Naturally, this new policy orientation became opposed to the energy policy community because such activities were regarded as excessive governmental and institutional intrusion. In short, any activities (except energy projects that fall within the Administration's overall economic recovery plan) could be construed as planning and therefore become suspect. Instead, the marketplace is seen as the proper policy tool to define the nation's energy agenda.

The Reagan Administration saw our energy supply dilemma solvable when accepting two general themes.¹²

1. The geological structure of the United States holds huge quantities of conventional energy resources yet to be found and produced.
2. Those resources had not been found and extracted because of counterproductive federal policies.

Production would be the order of the day. James Edward, the Administration's first Secretary of Energy, acknowledged that the Reagan energy approach was designed to produce, produce, produce.¹³

The result has translated into a sharp increase in domestic production in conventional resources (principally nuclear and fossil fuels) with a sharp decline for research and development funding for renewable resources and conservation.

The National Energy Policy Plan

As required by title VIII of the Department of Energy Organization Act (Public Law 95-91), each Administration reports its energy policy agenda through the annual publication of the *National Energy Policy Act*. Under the Reagan Administration, these energy policy goals encompass three broad conceptual objectives. They are energy stability, energy security, and energy strength.¹⁴

These three interrelated objectives reveal the specific energy resource preference and implementation strategies by the Reagan Administration. Therefore, a close evaluation in each category is required.

Energy Stability

Energy stability is defined as problems of energy availability and price, which destabilize the US economy and our way of life.¹⁵

To solve this dilemma, the Administration is pursuing programs that would not inhibit "energy access" for the increased production of domestic coal, oil, natural gas, and nuclear energy resources. Unfortunately, there is nothing innovative about this approach. In fact, the solution to the dilemma is describing pre-1973 energy strategies; that is, an energy condition of abundant and cheap nonrenewable resources required to "fuel" our economy and to maintain and promote a standard of living.

Since coming to power in 1981, the Reagan Administration has cited its contributions to abundant and cheap energy which include:¹⁶

- The price for world oil has decreased by more than 40%.
- Domestic oil production has increased annually since 1981.
- Nuclear energy has surpassed oil, natural gas, and hydroelectric power to become the second largest source of electricity in the United States. Nuclear power plants currently provide more than 15% of the total electric generation, second only to coal.

- The Strategic Petroleum Reserve (SPR) tanks provide a 120 day oil supply based on 1985 import levels as compared with the 1980 levels of 17 days based on 1980 import levels--a difference of 100 million barrels in 1980 to nearly 500 million barrels today.

Despite these advances, the Reagan Administration warned us not to become complacent about its successes when observing the following:¹⁷

- Areas of significant potential oil and gas reserves onshore and offshore are being delayed or foreclosed from exploration and development.
- No new nuclear power plants have been ordered in the United States for domestic construction since 1978, and 75 nuclear plants once scheduled for construction have been canceled since then.
- Less than three gigawatts of new coal-fired electricity capacity have been ordered since 1981.
- Some indexes of exploration activity and drilling are now lower than at any time in the past six to eight years in the United States.
- The Energy Information Administration projects declines in domestic oil production after 1990 and corollary increases in oil imports.

The intent of energy stability is to provide abundant and cheap energy. However, the decisions affecting the ownership and supply of these resources continue to be relegated to the existing elite energy producers who are committed to maintaining a centralized distribution of ownership for all factors of energy production. This policy may result in a new energy mix via the rapid depletion of domestic oil and gas resources for the production of nuclear and coal processes.

For example, it should be evident that a marketplace approach in the energy sector does not maximize individual preferences because choice and resource use are a function of the elite centralized energy suppliers. They promote and manage the energy

structures under which consumers may operate. We do not make decisions on what fuel we will use for our cars but rather which fuel station and at what cost per gallon. Not only are the centralized distribution of resources maintained, but the incentive to command energy production and distribution is basic to ensuring their livelihood and prosperity. Unfortunately, this direction has produced a society dependent on a nonrenewable energy-intensive economy .

In terms of financing a guided evolution, the strategy is straight-forward: unrestricted oil and natural gas supply keep industry and consumers satisfied (with the potential for a return to demand levels of pre-1973) while its revenues finance the next generation of centralized resources (the Energy Triad) and diffuse the importance previously given to an array of supplemental renewable resources. Statements drawn from the National Policy Act of 1985 reinforce these directives:¹⁸

Americans must focus their consumption on what is at hand. This means that for many years to come the United States will need more gas, oil, and coal from its domestic resource sites, including inland federal land sites and the federally managed outer continental shelf. Our people should be able to count on nuclear energy.

As natural gas and, in particular, oil resources decline in abundance, the price of these two fossil fuels will increase, serving to reinforce the nuclear and coal "alternatives." This process will appear to be the invisible hand of market-mechanisms, seeking abundant and cheap resources whose natural response will push nuclear and coal fuels to the forefront.

In the concluding paragraph for energy stability, the Reagan Administration orchestrates language replete with signals that will continue to advance the decision making of U.S. energy policy into the hands of today's few and centralized conventional energy (nonrenewable resource) camp. For example:

Market-oriented policies that build upon America's vast production and

conservation resources and its technological genius, free of arbitrary regulation, provide the best hope of maintaining the momentum of energy progress of the past five years.¹⁹

As noted, these "market-oriented policies" translate to oil and natural gas production from domestic onshore and offshore sites. The use of "conservation resources" indicates a prudent public relations tolerance for energy efficient programs, although the Energy Security category will expound upon how energy efficiency is defined as programs mediated by price. This means withdrawn federal funding affecting state conservation programs which, by and large, displace conservation from being a part of the national energy mix.

Also, the tendency to purchase less expensive consumer items (that are typically less energy efficient) is greater when the majority of consumer choice is dictated by price alone. Only the more affluent can afford to invest in long-term energy efficient consumer goods. Finally, the "technological genius, free of arbitrary regulation" is a clear policy plug for the expansion of nuclear power amid federal financial favor and the deregulation of existing licensing and operating provisions. These regulations are described as arbitrary--rules without thoughtful or appropriate consideration. Due to the energy establishment's investment commitments in nuclear energy, its highly centralized form of distributions, and its ability to produce uranium for military purposes, the Administration is dedicated to increasing nuclear energy use.

As we continue to assess some impact of the Reagan "marketplace approach," it is instructive to note changes in the abundance, cleanliness, and security goals inherited from the 1973-74 oil embargo crisis. These goals were strategies designed to define and set priorities in national energy policy formulation. With respect to energy stability, we will confine our initial review to the related concept of abundance.

The original abundance strategy noted that in a time of abundance, energy supply increased energy demand. However, the oil embargo made clear that surplus energy would be protected only by a conscious national policy. Otherwise, the nation would be faced with redefining what "abundant energy" meant. The Reagan Administration redefined "abundant energy" by the following means:²⁰

- Emphasis was on extraction of supplies rather than reduction in demand.
- Energy conservation was seen as a major contributor to economic stagnation except when motivated by market-determined price.
- Conservation was considered a reflection of a "no-growth mentality."
- The means to increase energy production was to release the private sector from federal regulation while using federal stewardship for the 762 million acres of publicly owned land as its primary contribution to bring resources into the "energy marketplace."
- Although in agreement with the Carter Administration as to energy price deregulation, the Reagan Administration sought the decontrol of oil prices more rapidly and in 1983 recommended the same for natural gas.

Energy stability is describing energy access. It is a concept of abundant and cheap energy to ensure economic growth--the real goal. The Administration's success and concerns to secure an energy-stable environment clearly illuminates its strategy, which is the expanded extraction and use of conventional domestic resources: oil, natural gas, coal, and nuclear processes. Nuclear, coal, and selective conservation measures--mediated by price--are the three resources slated as long-term substitutes. These resources are known as the Energy Triad.

This energy stability policy did not address three fundamental concerns. These concerns will be more fully discussed within the Alternatives Section. First, their solution did not approach the source of the problem, which is our structural dependence on nonrenewable resources for a large percentage of our transportation and industry sectors. Second, the adverse and potential nonreversible environmental quality and safety issues affecting local and regional populations from the expanded production of domestic resources are primarily entrusted to a market-mechanism whose primary goal is based on a profit motive. Under these conditions, production processes that increase the cost of extracting, refining, distributing, and using these resources will be passed on to the consumer. In an effort to make these resources more price competitive and profitable,

market-mechanisms will inherently seek the greatest reduction of existing and potential legislative safeguards enacted for the public good.. Third, both near-term substitution resources (nuclear and coal) enhance a centralized distribution of fuels and ownership within the dominate conventional energy decision makers of today. Based on our energy-intensive economy, it is unsettling to surrender--to a large extent--the direction of our society to a group of decision makers exempt from electoral scrutiny or approval.

Energy stability is describing energy access designed to preserve a stable economy and a way of life. This issue is solved by the increased domestic production of conventional resources. As domestic supplies of natural gas and oil resources decline in abundance, the guided evolution to use nuclear and coal resources is achieved by their comparative price advantage. For the Reagan Administration, the concept of energy scarcity is not a fact. The resources are there. What must be removed are the obstructionist regulations that prevent the extraction and use of gas, oil, coal, and nuclear processes--conditions that are denying the capabilities of an industrialized nation to produce cheap and abundant fuel that the society wants.

Energy Security

Energy security and energy stability are closely related within the Reagan Administration. They share the goal to secure energy supplies at reasonable costs.²¹ However, energy security is mostly concerned with programs to make America less vulnerable to disruption from foreign sources of energy. In response to this condition, the Reagan Administration advanced five provisions to enhance our energy security. They were emergency preparedness, international energy security, research and development, domestic production, and efficiency in energy use.

Emergency preparedness

Four objectives are cited to satisfy this provision:

1. The building of the Strategic Petroleum Reserve
2. Support for the diversification of energy technologies and applications

3. Improving relations with allied countries
4. Dismantling U.S. price controls

Support for the Strategic Petroleum Reserve (SPR) may not be an accurate portrait. True enough, the Reagan Administration accepted the SPR but did not support the "budget busting" costs of purchasing oil for the reserve.²² In cooperation with Congress, funding for the SPR was moved into an off-budget category.²³ As of January 1983 the SPR contained almost 300 million barrels, well short of the projected national goal of 750 million barrels.²⁴ Despite the resistance for a timely means to meet the SPR national goal, the Reagan Administration sought to take credit for the purchasing levels that were allowed: ²⁵

Since 1980, the supply of oil in the SPR has more than quadrupled. Thanks to these farsighted efforts, the United States is now much better prepared to cope with potential disturbances in the world oil market.

A clearer indication of the Reagan Administration's resistance to SPR quota goals is reflected in remarks that followed its self-congratulatory farsighted efforts:²⁶

Current market conditions (lower U.S. import levels and large amounts of excess oil production capacity in the world) reduce the potential dangers from oil supply disruptions in the near term. The Administration will continue to review SPR fill rates to be certain that the insurance provided by the reserve is maintained in a cost-effective manner.

There are several problems here. First, good business sense would acquire any commodity (in this case oil) experiencing a temporary surplus, especially where such a commodity is a basic input for most forms of industrial activity--in effect, capitalizing on the dumping of oil supplies on the world market. Meanwhile, due to the past economic success experienced from members within the OPEC cartel, it is very likely that OPEC will satisfy internal divisions over any one member enjoying disproportionate oil revenues in order to guarantee a stable regional base-rate. Reduced production or sale of oil will follow. Second, the "incentive" to increase SPR revenues is further advanced when recognizing that oil is a finite resource; it is pivotal to the economic stability of our

current nonrenewable energy-intensive society: the opportunity of today's oil market conditions are time bound.

With respect to supporting the diversification of energy technologies, funding directives in the Department of Energy (as noted from the graph on page 4) skew federal financial diversification in favor of breeder nuclear reactors. Structural changes within the Department of Energy, the Environmental Protection Agency, and the Department of the Interior (to be discussed in detail within the Alternatives Section) indicate the "diverse" methods that focus on increased domestic conventional resource exploitation and application. The Reagan Administration's efforts to diversify are not in doubt; however, the definition was limited to the direction of the Reagan Administration's overall Economic Recovery Plan.

Item 3, improved relations with allies, is not expounded upon in the annual publication under review. There are some issues raised in the International Energy Security area that may address this issue.

Item 4, dismantling US price controls, has been achieved for oil with partial decontrol for natural gas. The Administration (hereafter in reference to the Reagan Administration) asserts that price controls discourage producers from exploring and producing more natural gas; if prices were completely decontrolled, this would act as an incentive to produce more natural gas with the potential to sell the excess supplies. The argument for decontrol of natural gas pricing accomplishes two Administration goals: the increased production of domestic resources and the maintenance of the abundant and cheap energy goal sustaining our energy-intensive economy. Neither goal is addressing long-term solutions required to convert an economy based on finite resources. And should surplus natural gas and oil drive the competitive price down, we are missing a rare opportunity to keep the rates artificially higher to acquire federal R&D capital for nonfinite resource directions plus ensuring a lower rate of domestic consumption, thereby generating a longer time-lag to convert to processes that will create a less energy-intensive economy. Such a surcharge would likely be defined as governmental intrusion on private industry despite the fact that these policies would begin to address the vulnerability all citizens face in light of unpredictable oil imports.

International energy security

Recognizing the interdependence as well as the independence of other nations, the Administration seeks to promote a stable and secure world energy environment.²⁷ However, "America's international policy toward energy security reflects its domestic goal of reducing government intervention to allow markets to function more freely."²⁸ On the international scale, the Reagan regime cited its strong leadership role within the International Energy Agency (IEA), established by the agreement on an International Energy Program of 1975. Within this forum, the Administration has promoted measures to enhance mutual energy security. Among these measures, four parts are noted:²⁹

1. To promote or create open energy markets (emphasis: oil imports), to encourage greater energy production of all types, and to foster greater energy trade
2. To concentrate on "secure resources," thus avoiding undue dependence on any one source of energy supply, and also reducing vulnerability caused by disruptions of resources
3. To maintain adequate oil reserves and coordinate early use of stocks among IEA partners in event of supply disruption
4. To enhance international collaboration in research and development via consultations and joint program planning, thus improving economic efficiency and the rate of technological development

Item 1 runs counter to the financial interests of the OPEC supplier states because their profitability may be greater if OPEC can maintain an artificially higher rate of purchase by controlling production supply. For this reason, total success at promoting an "open energy market(s)" should be deemed suspect. On the other hand, if such a policy can be achieved, even in part, then the time required to transfer our energy-intensive society to a more appropriate mix of available long-term resources will be enhanced. The passage promoting the "greater energy production of all types" is, I believe, this Administration's acknowledging alternative resources but ultimately preparing the public to accept increased domestic oil, coal, and nuclear production,

especially when defined along a "marketplace approach," which in the absence of federal economic incentives, does not encourage alternative energy technologies.

Item 2, concentrating on secure resources and avoiding dependence on any one source of energy supply, presents another policy justification to support the expansion of domestic oil, coal, and nuclear energy resources. I believe it is safe to assert that all of us can support the concept of avoiding undue dependence on any one source of energy supply. The real question is, should we confine our policy of secure resources to the increased domestic use of oil, coal, and nuclear technologies as compared with the renewable and universally secure resources of wind, water, or solar technologies?

Item 3, adequate oil reserves and early use of these stocks among IEA partners, is designed to circumvent panic, hoarding, and sharp increases in oil prices. This condition would be most adverse for the United States and our allies because of our joint level of consumption. At best, our SPR may sustain 180 days of supply at current 1987 levels of imports. There are two problems with the insufficient level of oil in our Strategic Petroleum Reserve. First, six months' or even twelve months' operating schedule does not provide a reasonable time frame for stable energy decision making. Instead, crisis management may go into effect. Consequently, the drilling of domestic oil reserves along the Outer Continental Shelf and inland sites, under reduced regulation, will be promoted and likely approved for purposes of "national security." Second, a protracted oil import embargo (or the threat of one) increases the possibility of United States conventional military forces operating within the Middle Eastern region, given the climate of oil disruptions directly affecting the business ability of American industry and transportation.

Item 4, enhancing international collaboration, can produce highly successful resource efficiencies. For example, it should be obvious that, on a comparative basis, the United States could benefit by studying and adopting several European approaches to housing and transportation systems forged out of the adaptability requirements of their more expensive energy import costs. Unfortunately, these adaptations run counter to the current Administration's orientations and energy business interests, which seek to ensure a market for the resources they currently control colored in terms of providing for the "maintenance of our way of life." It should be clear that those energy technologies likely

to survive and prosper in the next several decades will not necessarily be the most efficient, most socially or physically benign, or most technically elegant; instead, they will be those technologies able to create and sustain a supportive political environment.³⁰ What really may be distressing is that our assumed national leadership role in IEA strategies may--in actuality-- require us to listen and emulate our allies' solutions, especially given our level of singular American energy consumption. Ultimately, today's energy goals do not reflect efficiency through structural conservation. The goal is to produce, produce, produce.

Research and development

The approach to R and D is immediately qualified by the first topic sentence: "Appropriate investment in R and D is fundamental to energy security."³¹ Again, reflective in the current fiscal levels for R and D, the term "appropriate" favors nuclear technology. Despite the financial disparities in federal energy appropriations, this section asserts that its energy R and D focuses on "all" sources of energy and on the effect of energy activity on human health and the environment. Personnel and funding reductions within the Department of Energy and Environmental Protection Agency indicate opposite conclusions. In general, the R and D approach is designed more to complement the initiatives of the private sector than compete against it or skew national economic incentives through random subsidies.³² Within the R and D process, five distinct steps are identified. They are basic research, applied research, proof of concept, process development, and commercialization. The Administration notes that its federal efforts will only focus on the earlier phases of the process, for it is the private sector that will select the technologies that will ultimately gain market acceptance; economic feasibility of the later, more expensive phases of R and D will be left to the marketplace. However, this policy does not apply across the board. With respect to nuclear energy, it is willing to undertake pre-commercial stages of higher risk projects that show potential for large long-term benefits but would not be cost effective for private organizations because of their inability to reap the benefits and because of the projects' high cost, uncertainty, or likely slow payoff.³³

The nuclear industry's ability to maintain a supportive political environment is starkly apparent by the above justification for "federal subsidies" and exempt status of

marketplace mechanisms. In addition, it is the only energy technology that enjoys a federal law (the Price-Anderson Act) limiting liability in the event of a nuclear industry accident, without which, most experts say, the private use of nuclear power would not have progressed as far as it has.³⁴

Domestic production

The theme for domestic production of resources has been raised many times. Three familiar strategies to actualize this goal encompass the extraction of oil and gas from the Outer Continental shelf region, the elimination of the remaining federal price controls on domestic natural gas, and the promotion of coal production drawn from federal lands. This process would be in accordance with strict environmental safeguards. However, two additional domestic production strategies are also brought to the surface. They include restoring U.S. primacy in uranium enrichment and providing a stable and predictable regulatory environment for the efficient and economical production of energy.

Clearly we see the level of commitment by both the Administration and the nuclear industry to promote domestic power plants and be in a position to meet both domestic and overseas uranium market demand. Secondly, as long as environmental regulations are limited by an economical criterion, the marketplace approach will inherently seek abundant and competitively priced resources while minimizing the costs associated in the regulatory safeguards of the extraction, refinement, transportation, and conversion of nuclear, oil, gas, and coal resources.

Efficiency in energy use

Whereas the first four provisions within Energy Security received fairly thorough policy elaboration, provision five--efficiency in energy use--is presented, summarized, and concluded in one paragraph. This may suggest that the concept of promoting and improving efficiency in energy use through certain federal programs is, to say the least, a low to a nonexistent Administration priority. For example, energy productivity--defined as the nation's economic output per unit of energy consumed--improved nearly 16% between 1980 and 1985, the greatest improvement in efficiency since World War II.³⁵ Accordingly, the Reagan administration believes progress in

energy efficiency can be achieved with a de-emphasis on "mandated conservation." In sum, the Administration perceives market forces and private initiative, not government programs, as the best promoters of further improvement in energy efficiency. The irony of these pronouncements is that the strategy of market forces and private initiative, within the energy industry, is precisely what has produced our current energy dilemma, that is, an energy intensive society based on finite resources, unpredictable suppliers, and compromised environmental standards.

In general, energy security programs are geared to make the United States less vulnerable to disruptions of energy resources by foreign suppliers. As noted, there are five provisions to achieve energy security including emergency preparedness, international energy security, research and development, domestic production, and efficiency in energy use. Within these provisions the following common themes prevail:

- The private sector is the best policy tool to decide the energy mix of the future.
- On an international scale, we hope for robust international energy trade while pursuing increased domestic energy production.
- Research and development is limited to early phases of basic and applied research except for the commercialization of nuclear technology.
- Domestic production encompasses the increased extraction of oil, natural gas, coal, and uranium resources. Federal regulations governing the extraction, production, and use of these resources should be measured against cost effective economical standards; those not satisfying these criteria should be deemed wasteful and be removed.
- Energy efficiency, defined by private initiative and the marketplace, will not achieve broad-based consumer participation unless the energy establishment can assure a financial stake in the technology promoted while pursuing the rapid depletion of available domestic nonrenewable resources.

Energy Strength

Energy strength is the third broad policy goal of the Reagan Administration. The policy is to create a *future* where resources are used effectively to strengthen the economy and security of both the United States and our allies.³⁶ Energy strength therefore is a focus on a future of energy strength in order to maintain a prosperous economy and a stable and united Western alliance (NATO, SANTO, ANZAC). The policy and resources cited to achieve energy strength evoke some reoccurring themes from the energy stability and energy security sections. In essence, the decision making future for our national energy policy is to remain with the marketplace amid an environment of free choice, industrial inventiveness, innovative technologies, and decisions applicable to regional or local conditions.³⁷

Resources that fall within future planning include nuclear, coal, and selective forms of conservation mediated by price. However, oil and natural gas are not abandoned. Instead, the energy strength section is also a focus on the future fuel importance of oil and natural gas. To assess the rationale of these three "future fuels," a brief analysis per fuel source is in order.

Oil and natural gas

Fossil fuels provide two thirds of the commercial energy used in the United States, and they are projected to be furnishing more than one half the commercial energy use in the year 2000.³⁸ From this perspective, the Administration's future for the country is inextricably tied to oil and gas development. To suggest otherwise would be foolish.³⁹

To achieve this development, the "vital component" of federal actions is the timely development of fossil resources on the federally managed outer continental shelf and inland sites. Delaying the development of these known reserves invites four negative ramifications:⁴⁰

1. Increasing OPEC's efforts to control production and the price of oil energy

2. Increasing the nation's dependence on imported oil
3. Decreasing the nation's energy security
4. Decreasing the pace of economic growth

There are several problems with the Administration's pronouncements. First, whether or not the United States is pursuing a policy of rapid domestic fossil fuel production, it is always in OPEC's interest to moderate production and thereby artificially maintain higher oil rates. However, the incentive for OPEC to depress production artificially is increased when the principal consumer (the United States) is forging a program of rapid domestic oil production, which may contribute to OPEC's oil surplus dilemma. Indeed, the OPEC cartel may recognize that it is within its interest to invite United States development of its remaining finite "fuels of convenience." With our domestic resources nearing depletion and with potential higher consumer costs from "enhanced" extraction oil processes, OPEC's potential ability to capitalize on our consumer habits will increase, not decrease, our dependency on foreign sources of energy. The rapid development of our domestic reserves is not responding to the source of the problem, which is, in part, a society structurally dependent upon finite fossil fuels for private and commercial transportation. The most stable method of lowering OPEC's prices is to lower our energy demand via permanent structural changes in the way our society consumes fuel for its industrial and related transportation, business, and private use. In this way, the nation satisfies two other concerns by decreasing our dependency on imported oil and increasing our energy security. Proposals to alter our consumer habits are explored in Section II--Alternatives.

Item 4--decreasing the pace of economic growth by the delay of the production of domestic oil--is a statistically false assertion and prolongs the use of a finite energy system, thereby giving the U.S. consumer a false sense of energy security and decreasing his energy fuel use options. First, the Reagan Administration itself has acknowledged that sustained economic growth has been achieved in unison with decreasing levels of energy use as compared to 1973 consumption levels.⁴¹ There is research available that proves the relationship between national energy consumption and economic growth is not linear.⁴² Indeed, statistics brought forth by the Reagan Administration acknowledge that in 1985 the nation consumed 17% less oil as compared with 1978 despite a 7% increase in population and a 16% increase in the Gross National

Product.⁴³ Second, the focus on fossil fuel production is perpetuating an antiquated system of cheap and abundant resources that are domestically diminishing and internationally unpredictable. This condition itself should justify energy programs designed to reduce our domestic use and dependency on fossil fuels. In addition, the use of fossil fuels to "drive our economy" is counterproductive to the health and quality of life to all U.S. citizens. Cumulative exhaust fumes are down-grading the quality of air and advancing the scientific concern over the global greenhouse effect. In short, if our national greatness is predicated upon an economy whose viability is manifest in the inherent requirement for expansion that, for the present, is largely based on the use of finite fossil fuels, then indeed, we have reached a national tradition no longer sound nor applicable to the energy facts of the late twentieth century.

Coal

As a future resource, coal enjoys a primary position of favor for the Reagan Administration. First, coal accounts for about 80% of the recoverable fossil fuel resources in the United States; there is enough coal in this country to satisfy the nation's current use rate well into the twenty-third century.⁴⁴ The structural supports for increased national coal consumption are statistically pointed up by the Administration. They include the following:⁴⁵

1. Since 1973, coal's share of the U.S. energy market expanded to about one third of the nation's overall energy mix.
2. Utilities generate approximately 55% of all electricity using coal. This is to be an indication of its fuel preference.
3. The federal government has jurisdiction over more than 30% of the nation's coal reserves, which it will make available for lease to private producers.
4. Fluorided-bed combustion and coal-gasification combined cycle plants offer less cost at higher energy conversion efficiency, provided regulations are flexible enough to accept these new technologies that

possess potentially excellent environmental performance.

For this Administration, two problems prevent its ability to plan a "coal future": first, public opposition to "flexible" regulations that affect the extraction, conversion, and use of coal because of the likely greater allowable levels of sulfuric emissions. Second, there is public resistance to this Administration's desire to lease larger amounts of federal land for coal production.

Coal can be best described as an abundant resource with abundant problems.⁴⁶ Chiefly, coal is a fossil fuel source contributing to global climatic changes caused by its emitting carbon dioxide into the atmosphere. Second, coal produces the environmental problems of acid rain, which are not limited to adversely affecting just the national boundaries of a given producer state. Our neighbor Canada knows all too well the painful truism of acidic rain "knowing no boundaries."

Ideally, coal should be high in heat content but low in sulfuric impurities. Unfortunately, of the four main categories that constitute coal sources in the United States, only 2% of our coal reserves are drawn from the anthracite grade, which is low in sulfur and high in heat. The bulk of the coal reserves (52%) is bituminous, which is high in heat and high in sulfur.⁴⁷

Coal has achieved the category of a future resource from its undeniable domestic supply. However, even if technological breakthroughs in coal conversion are realized (more heat with less sulfuric by-products), such advances are counterbalanced by the environmental costs caused by the increased aggregate production of coal. Moreover, as long as "abundant and cheap energy" represents the axiom of direction in this Administration's U.S. coal policy, then capital costs to comply with air-quality regulations will be deemed a significant direct cost on coal-fired power plants.⁴⁸ From this perspective, the Administration will likely seek to modify the financial impact of such safeguards in order to retain the goal of coal price competitiveness.

Nuclear

Based on federal expenditures and policy pronouncements, nuclear energy is the primary future energy source under the Reagan Administration. To increase the energy percentage mix for nuclear energy, the Administration is pursuing a fivefold plan:⁴⁹

1. To proffer specific legislation for licensing and regulatory reform
2. Expansion of facilities for high-level waste and storage of spent cells
3. Increased research and development funding to promote safety margins and standardized plant designs that will enhance the production of more usable systems
4. A public relations campaign to make the American public better informed on the how and why of peaceful nuclear power
5. The removing of barriers to technological and equipment exports that do not encourage the spread of nuclear weaponry

Unfortunately, the enormous benefits from a seemingly inexhaustible and powerful supply source--nuclear energy--carry fixed and potentially irreversible social and environmental costs: specifically, the inherent risk posed by the production of radioactive material. Within this risk, there are concerns regarding the transportation and long-term storage of spent nuclear pellets. In short, no matter how effectively energy can be produced from nuclear sources, a by-product of the production process--radioactive material--is inescapable. Conversely, as long as the goal for abundant and cheap energy retains its place of prominence in our energy policy, the rationale to develop nuclear energy will be justified due to our domestic uranium sources and the potential "cheapness" to produce nuclear energy with the introduction of breeder reactors. Breeder reactors can multiply the reactor fuel supply seventy fold.⁵⁰ However, breeder reactors convert uranium to plutonium, a primary element in the construction of nuclear arms. There is obvious concern that the increased use of nuclear breeder reactors--nationally and internationally--will proportionally increase the chances

of undesirable nations or organizations gaining access to the nuclear club. Despite these risks, the current Administration is committed to the expansion of the U.S. commercial reactor industry.

Renewable and alternative fuels

Renewable and alternative fuels are not given the breadth of recognition they require. Instead, renewable resources under this Administration are defined as wood and water resources.⁵¹ Wood and water renewable fuels contribute about 9% of the country's domestic energy production. Research and development for solar and "other" renewable energy resources is said to be addressing "high-risk technical issues" to provide a scientific and engineering base for industry to produce systems with greater efficiencies, longer systems life, and lower system cost, based on the use of new materials.⁵²

When solar energy falls within verbiage of "high-risk technical issues" and nuclear energy is described as "peaceful nuclear power," it should be quite evident which energy preference this Administration is supporting and which one it is not emphasizing.

In sum, energy strength is policy planning for future resources. Resources that apply in future planning are nuclear, coal, and selective forms of conservation mediated by price. To finance this transition, rapid domestic development of oil and natural gas becomes the order of the day. The crucial component of this approach is the timely release of the federally managed outer continental shelf and inland sites to oil and natural gas producers. To assess the Administration's rationale for these future resource fuels, a brief discussion per fuel source was undertaken. Within each area, several concerns were raised. Chief among them are the following:

- The rapid depletion of our domestic oil and natural gas reserves poses adverse and significant environmental costs that reinforce the consumer dependency on finite resources, increase the global greenhouse effect, and encourage OPEC nations to decrease production more rapidly because of the

market surplus produced by increased U.S. domestic production. This may serve to aid the justification for the nuclear and coal fuel(s) substitution, based on a price motivated criterion.

- Coal inherently jeopardizes the U.S. standard of living by reducing the quality of life. Unless the conversion of coal to energy can avoid discharging impurities into the atmosphere (causing acid rain and adding to the greenhouse effect), its proposed increased application carries irreversible environmental costs that reduce the quality of life for all concerned.
- Nuclear energy produces radioactive material. Spent cells must be transported and stored, for all practical purposes, indefinitely. Also, nuclear plants are expensive to construct and operate. The tradeoffs with the potential expansion of breeder reactors has been termed a plutonium economy. A plutonium economy may increase nuclear proliferation among undesirable governments, organizations, or individuals.
- Renewable and alternative fuels are not a priority item of this Administration. Wood and water resources are defined as renewable energy. Alternative energy, such as solar and the all-inclusive "other" category given, are resources that are--for all practical purpose--recognized and tolerated, but obviously not supported.

Summary of U.S. Energy Policy Under the Reagan Administration

Energy policy under the Reagan Administration embraces three policy goals: energy stability, energy security, and energy strength.

- Energy stability includes programs that predominantly promote access to conventional energy (oil, gas, coal, and nuclear) from domestic sources.
- Energy security includes programs to reduce the United States' vulnerability to potential disruptions of energy supplies by foreign sources.
- Energy strength is program planning to acquire "future" resources to ensure a prosperous economy and unified Western alliance.

Within the energy stability category, the energy access dilemma is solved by increasing production of domestic gas, oil, and nuclear resources while decreasing regulations or other programs that may inhibit a pro-production agenda. Simultaneously, the Administration seeks to counterbalance the vulnerability issue through its energy security programs: namely, the five categories identified as (1) emergency preparedness, (2) international energy security, (3) research and development, (4) domestic production, and (5) efficiency in energy use. As the Administration responds to the present domestic and overseas energy condition, the issue of future resources is satisfied with the introduction of the energy triad promoting nuclear, coal, and selective forms of conservation mediated by price.

All three interrelated goals are designed to recognize and reinforce a fundamental premise that promoted our nation's industrial growth and standard of living--the access to *cheap and abundant* resources to fuel our economy and way of life. As a consequence, the United States has evolved into a society where citizens' expectations are marketed and satisfied within the context of an energy intensive economy. This premise may be appropriate, except that the current basic economic inputs are finite, ecologically adverse, and internationally unpredictable.

Now, as proposed by this Administration, the direction of the present and future United States energy agenda is to be relegated to the "marketplace." This marketplace is made up of presumably apolitical energy corporate managers whose primary interest is to provide cheap and abundant energy, which will enable more sales and therefore more personal and corporate income. Given the nation's dependency on potentially hostile foreign suppliers of oil and the environmental costs of nonrenewable resources, the public at large, and public policy decision makers in particular, may soon develop less faith or affection in the profit motive defining our national energy policy. Moreover, this approach has produced the nation's structural dependency and current energy dilemma. A regression to the pre-1973 energy decision making will only delay, not respond to, our energy scarcity and related economic vulnerability. If anything, such programs will increase the justification for a nuclear and coal fuel(s) transition and reinforce the influence of the conventional energy camp decision makers, thereby raising their commitment to command all factors of energy production (and remove what will likely be described as public interference in private enterprise) irrespective of the nation's long-term interest affecting our national security and quality of life.

The alternatives section will seek to identify the less visible variables and actors affecting our energy policy, within which some key conceptual differences between this Administration's energy policy orientation and the author's exist, including the following:

- Market mechanisms do not strictly apply to the highly centralized energy industry.
- The direction of the society surrendered to decision makers comparatively exempt from electoral accountability presents dangers to our democratic foundations and our ability to avoid war over the preservation of overseas energy suppliers.
- There is a need for structural transformations in the way our society produces and uses energy to yield increased efficiency in energy use and thereby maintain and conceivably advance the standard of living via the stabilization or reduction of the cost of energy.

- The decentralization of consumer energy supplies in the operation of businesses, heating homes, and transportation should take place.
- We must recognize "quality of life" as a key component in the equation of standard of living. Its success is realized by reducing consumer dependency levels on fossil fuels, nuclear, or other forms of technological applications that present adverse and potentially expensive or irreversible damage to the air, water, and land defining our local and national existence.
- The fundamental direction and future values of our country involve energy policy and therefore should receive special policy attention and decisions that are reviewed and endorsed by the nation as a whole, not a comparatively small group of energy industrialists motivated by profit and the retention of a comparative monopoly on the energy resources and services available to American business and consumers at large.

SECTION II

ALTERNATIVES

Issues at Hand

My interest and concern for our energy policy is motivated by the realization that although a world leader and an industrialized nation state, we are largely dependent on finite and unpredictable resources to feed our economy. This means our capacity to formulate energy policy that can properly address long-term solutions with respect to environmental concerns and the promotion and support of other western democratic governments can become secondary priorities given a political landscape for energy expediency in a perceived or real energy crisis. For example, coal and nuclear power possess obvious environmental and cost liabilities yet, in an energy emergency, their undeniable domestic supply will assure their mass substitution at least for the near term. Also, our government's ability to penalize regimes that represent dictatorships (left or right wing) can be neutralized for purposes of maintaining our relations with an energy supplier state. Naturally, this condition presents a volatile variable in the desire and design for a successful formula for peaceful coexistence in East-West relations. Therefore, every effort to minimize resource scarcity forming the catalyst for an East-West confrontation should be avidly pursued and implemented. This is not to disregard the fact that an energy struggle is already underway in the form of military and material aid marshaled to our respective energy suppliers and allies.

Our nation is both a major producer and consumer of energy. Therefore, the success or failure of our energy policies play a significant role in both our domestic economic stability and for global economic stability. However, we are an energy intensive society that has arrived at a precarious state of national vulnerability. To solve this condition, we must decrease our foreign energy demand. This can be accomplished if we pursue policies that structurally transform the way our society uses energy:

namely, increasing energy efficiency use while developing substitution resources. This goal of decreasing foreign energy supplies and the introduction of substitution resources is identical to the Reagan Administration's policies and the diverse group of energy experts drawn from industry, academia, and interest groups. The means and emphasis, of course, differ greatly. The source of this difference may begin with how an Administration views energy .

Views of Energy

There are many ways to look at energy policy formulation. The four views of energy presented by the book *Energy Use, the Human Dimension*, provide an instructive insight into view points affecting the properties, values, and interests of a given orientation. Table 2 summarizes the important differences between commodity, ecology, social, and strategic viewpoints on energy use and development.

Table 2. Four Views of Energy

View of energy	Important properties of energy	Central values emphasized	Interests emphasized
Commodity	Supply Demand Price	Choice for present buyers and sellers	Energy producers Consumers with sufficient resources
Ecological resource	Depletability Environmental impact Effect on other resources	Sustainability Frugality Choice for future citizens	Bystanders to market transactions Future generations
Social necessity	Availability to meet essential needs (distribution)	Equity	Poor people Poorly funded public services
Strategic material	Geopolitical location Availability of domestic substitutes	National military and economic security	U.S. energy suppliers Military

Source: Amory Lovins *Energy Use, the Human Dimension*, 1987.

The Reagan Administration clearly represents the commodity viewpoint: the supply, demand, and price of energy resources coalesce in the marketplace to present energy choices to producers and consumers, thereby allocating energy effectively and efficiently.¹ I challenge this orientation. Until we create energy policies that appropriately respond to our sheer weight of global and domestic energy consumption, then the luxury of categorizing energy as a commodity is over. Instead, energy use and development must be regarded as a public resource, requiring public policy committed to solving the issues that have displaced energy resources position as a commodity. Programs that decrease our strategic vulnerability and ecological destruction satisfy key prerequisites in the process of returning energy procurement to a commodity issue. In the interim, the analysis of the Reagan Administration's three energy goals of energy stability, security, and strength sought to highlight those resources and technologies that are receiving preferential treatment as a consequence of conforming to the interests of the principal suppliers of conventional energy -- a policy justified when energy is viewed as a commodity. Unfortunately, the adverse affects of viewing energy as a commodity are many. Specifically, two themes summarize negative ramifications:

- The direction of our society entrusted to "apolitical" corporate managers
- Business interests versus national security--a chain reaction scenario

Direction of Our Society

The direction of our energy intensive society, that is, its material wants, services, industrial practices, transportation polices--in effect, our overall quality of existence--is in part, a product of our energy development. From a commodity viewpoint, decisions affecting energy development should remain within the private sector. However, the sector controlling the factors of energy production are highly specialized, centralized, and advance the needed structural changes in United States energy use provided such modifications support their economic agenda. Ironically, the U.S. energy industry(s) success in marketing a consumer dependency for conventional finite resources--to support our economy and lifestyle--has transformed energy use and development into a special public status. Energy access and use has become too basic an input to be surrendered to the interests of presumably apolitical corporate managers

within the U.S. energy industry. For if the commodity viewpoint prevails, then the direction of our society (which will reflect both domestic and foreign policies to support this direction) is abrogated to decision makers comparatively exempt from electoral endorsement or accountability. This presents direct and explicit dangers to the democratic governing principles of our nation. In addition, the preservation of overseas energy suppliers will, at worst, decrease our ability to avoid military interventions and, at best, undercut our ability to internationally represent the leading democratic regime by not being able to officially admonish less than democratic regimes either through official channels (world court protests) or tying military and material aid to demonstrating democratic governing practices.

Business Interest vs. National Security

There is a clash between a business orientation to energy resources and our national security. This confrontation is evident if we define business interests as profit motivated and national security as the maintenance and expansion of pro-Western allies acting as geographic buffer zones and advanced intelligence gathering posts. Business means profit and "enhanced" profit is achieved from a guaranteed consumer demand with limited suppliers, i.e., a monopoly. The commodity viewpoint defines energy use and development to a profit motive mediated by supply and demand. This would not be a detriment to our national security if energy conditions had not achieved the (previously defined) "special public status." Instead, today's business orientation ignores the new facts of energy scarcity and consequently the potential alternative energy developments. This undercuts our national security. Figure 3 illustrates how the process of a traditional business commodity viewpoint may adversely affect our national security.

Figure 3. Business Interest Versus National Security

Profit motive and centralized power generation

First, where profit becomes the primary motivating force, centralized power generation and distribution processes will naturally be favored and likely pursued. These developments seek to enjoy a lower unit cost through the advantages of economy of scale production practices. This strategy also reduces the competition from a collection of smaller suppliers because of the tremendous capital intensive investments required to become a member of the centralized national energy team. Indeed, a lack of other competitive suppliers becomes the logical good business approach to achieving and assuring the primary profit motive.

Centralized power generation is the organizing principle of hard (conventional) energy technologies. This structure will create and reinforce existing technological elite whose command of essential public resources is not essentially kept accountable to those dependent upon them.²

Inefficient use of energy

From the centralized energy systems of oil, natural gas, coal, and nuclear processes, inefficient energy use and resistance to decentralization will also follow. Examples of inefficient electricity energy use include the following:³

1. Conversion of petroleum, natural gas, and coal to electricity wastes about two-thirds of the fuel potential in the original source.
2. Conversion of coal through synfuels technologies for electricity wastes at least one-third of coal's energy potential.

The inefficient use of energy by traditional centralized power generation facilities is characterized by Amory Lovins, a U.S. physicist and environmental activist. He notes:

Plainly, we are using premium fuels and electricity for many tasks for which their high energy quality is superfluous, wasteful, and expensive, and a hard

path (conventional) would make this inelegant practice even more common. Where we want only to create temperature differences of tens of degrees, we should meet the need with sources whose potential is tens or hundreds of degrees, not a flame temperature of thousands or a nuclear reaction temperature equivalent to trillions --like cutting butter with a chain saw.⁴

Resistance to decentralization and maintenance of energy intensive consumer demand

The resistance to decentralized energy uses is straight -forward: the ability to secure consumer demand and limit suppliers lies in the maintenance of controlling the factors of energy production through the control and preservation of centralized energy facilities. From this context, the direction of our society reflects the centralized energy producers' ability to reinforce existing consumer demands and generate new wants based on those controlling the current or proposed production resources. Consumers do not set the agenda for the types of fuel they use, but rather, which of these fuel(s)--as selected by the energy establishment--are cheapest to buy. Whatever fuel source is made available, it is predictable that its design will be centrally produced and distributed.

Energy suppliers and the risk of anti-US sentiment

Unfortunately, the direction of consumer demands--dependent upon an oil intensive lifestyle--outstripped our domestic oil supply and therefore required foreign sources of oil energy. This begins our entanglement with overseas energy suppliers--principally nations of the Middle East and, on a lesser scale, nations of South America and Africa. Our dependency on these foreign energy suppliers (even if partially supplemented in the short term by increased domestic oil supplies or the prevailing foreign oil surplus) will continue to reinforce two prevalent U.S.foreign policy directives:⁵

1. A U.S. defined national interest to include the oil rich Persian Gulf whose defense will be "repelled by any means necessary, including military force."
2. A propensity to marshal arms, food, and aid as bargaining chips to secure access to oil and thereby finance an increasing number of rulers who are themselves combating rising nationalistic movements petitioning for a share of the nation's wealth and identifying the United States as the source for their economic and social inequality.

Indeed, large volumes of exports are increasingly seen as a sign of political subservience to the West. As the Sheik of Kuwait said in response to Queen Elizabeth's regarding his lavish welfare and development spending: "But Your Majesty, this kind of spending wins me fewer friends these days."⁶

Our foreign policy operating on a dependency mode among unpredictable suppliers is reprehensible. For our real ability to export democratic institutions and, more feasible, support regimes reflective of these institutions (which in turn supports our national security efforts through stable and popularly elected allies) is canceled by simultaneously pursuing "whatever means" are required to ensure access and supply of oil. The preservation of overseas energy supplier states will, at worst, decrease our ability to avoid military interventions protecting our defined sphere of energy territory and, at best, undercut our capacity to internationally represent the leading democratic regime by not being able to officially admonish less than democratic supplier regimes either through official channels (world court or the UN Assembly) or by tying military and material aid to demonstrating democratic governing principles and practices.

Without these safeguards, and where a majority of citizens (within a primarily energy producing state) cannot enjoy the new wealth of the country, their perception of the United States may conclude that our great democratic traditions and standard of living are not only confined to our borders but are subsidized at the expense of improving their condition.

Business Interest vs National Security--A Case Example

To illustrate some of my current energy policy concerns--specifically a private sector orientation in oil acquisition and its consequences to our national security--a brief review of the following chain reaction is in order.

Figure 3A. Business Interest vs National Security - A Case Example.

The Shah of Iran's last five years in power were far from democratic. The number of civilians "missing" either by the Shah's secret police or by a soldier's inability to distinguish a potential subversive from a noncombatant (especially in the heat of a street battle) suggest due process was not "a given" in the Shah's closing years of tenure. Dispatching troops to quell social dissent constitutes many steps removed from any semblance of democratic order. However, despite this turn of events in Iran, our previous Administration(s) continued to support the Shah's regime for oil access and military strategic purposes, i.e., a military intelligence gathering post on Soviet activities in the region. As a consequence, the reactionary regime that has replaced the Shah owes its success, in part, to our government's inability to override the desire for a pro-Western government at the expense of basic civil liberties for the people within its borders. It is always important to clarify the difference and potential ramifications of a pro-Western government lacking pro-Western governing institutions. Our executive branch and those voting in favor of continued funding of the Shah's regime failed to recognize and act on this simple principle.

Once Khomeini was in power, he consolidated his position by redefining the "true and appropriate" direction of Iranian society along a Muslim religious/fundamentalist direction, in which he was the most qualified to lead. In effect, not only did Khomeini want to "turn the clock back" on Iran, but he also advocated his system for the entire region. The Iraqi government, not comfortable with Khomeini's inciting religious fundamentalist elements within Iraq or the expansion of an Iranian based Muslim fundamentalist confederation for the region, exercised a calculated gamble by going to war against Iran. The condition of this war was in many ways similar to the early months of the German offensive against the Soviet Union in World War II. What the Iranians lacked in military hardware and sophistication (similar to the Soviets of World War II), they made up for in a near three-to-one numerical advantage. However, the reported use of mass troops charging fortified Iraqi positions revived images of the horrors of World War I trench warfare. The resulting casualty losses suggested another similarity: a lack of qualified or experienced officers. In the case of Stalin, many of his senior officer corps were eliminated during the political purges of the 1920s and 1930s. For Iran, the reorganized military forces likely suffered a high rate of officer desertion, internment, or worse, which may account in part for the antiquated tactics of mass assaults over open ground against fortified positions. With both sides suffering the loss

of large populations and equipment, a war of attrition slowly emerged. As each side attempted to maintain its battlefield positions and resupply for possible future assaults against the other, the emphasis on petrodollars' financing munitions and military hardware naturally received increased importance. So important, that we witnessed the unpredictable Tanker War in the Persian Gulf.

The Tanker War mushroomed into the "Persian Gulf Crisis" and prompted a U.S. response to reflag foreign ships with U.S. colors combined with the indefinite commitment of U.S. Naval ships as escorts. It would be politically naive to simplify our military presence in the Persian Gulf as "protecting the right of free commerce on the high seas." The crux of the issue is twofold: the maintenance of U.S. destined oil resources shipped through the Persian gulf, and to circumvent any undue Soviet influence in the Gulf as a consequence of the Tanker War.

In our drive for oil resources, we have lost an ally state and a Soviet listening post, gained an adversary state, witnessed an intrastate revolution of religious fanaticism attempt to go regional, and escalated our military presence in the Persian Gulf. These circumstances were the result of a post-advanced industrialized society that is thus far, governmentally structured to view oil as a "commodity" subject to supply and demand mechanisms. Few would wish to acknowledge that the "mechanism" affecting supply and demand includes the past financing of a *status quo* regime (irrespective of the lack of democratic institutions within its borders) and an increase in military commitment to protect a fleet of tankers whose host nation (Kuwait) initially prohibited its U.S. Naval escorts access to its ports for logistical resupply. The near criminal irresponsibility of continuing to view any singular dominate energy source as a "commodity"--which instead should require special public policy status--is akin to not acknowledging that our drive for oil contributed to the Persian Gulf crisis and placed our Naval forces in the unsavory position of protecting an oil trading partner who keeps us at arms length. The needless loss of American sailors aboard a missile frigate attacked by the previously regarded "friendly" Iraqi jet fighters and the downing of a civilian Iranian commercial jet by our mistaken identity checks (undoubtedly, a decision made in an atmosphere determined not to suffer any additional losses) mark two events that are sad, militarily embarrassing, and do little to promote a unified sense of national support for our presence in the Persian Gulf. Regretfully, good men have died and good men sail in

harm's way having little to do with preserving democracy and a lot to do with preserving an oil intensive lifestyle amid less than ideal trading conditions and trading partners.

In the final analysis, two phobias--the fear of foreign oil disruptions and Soviet influence in the oil rich region of the Gulf--have played a significant role in the chain of events, which unfortunately has precipitated the conflict in the Persian Gulf. Significant structural changes in the way we view and use energy is required if our nation's leadership is to avoid the policy errors that evolved into the Persian Gulf crisis.

Proposed Changes

Thus far, it is hoped that the basic tenets of the Reagan Administration's energy policy have been identified from our review of the national energy Policy Act. The goals of national energy stability, security, and strength are obviously highly desirable. Conversely, the existing policy paths to achieve these goals are subject to debate based on critical objections raised along technical, strategic, political, economic, ecological, and ideological lines. The following proposed changes approach U.S. energy policy making with a strategy designed to secure a *sustainable* end goal of national energy stability, security, and strength, independent of finite resources that may produce unpredictable international trading partners, volatile political relations, and ecological global risks.

New View of Energy and the Federal Role

There are two general premises that must be modified to effect a discernible and desirable change in U.S. energy policy--our view of energy and the federal role.

View of energy as an ecological/strategic resource

As expressed throughout this analysis, the commodity viewpoint is no longer appropriate given the new facts of nonrenewable energy scarcity with a history that has compromised desirable ecological and geopolitical standards. Today, a new orientation in energy acquisition and use should reflect an Ecological/Resource

perspective concurrently structured to satisfy a Strategic/Material view of energy. In affect, energy policy makers should view energy programs with respect to their environmental impact (not just price competitiveness), sustainability, geopolitical location, and the ability to stabilize and secure long-term national and economic security.

The federal role

Regional differences in energy use and supply should be recognized and reflective in the final draft of the new Ecological/Strategic energy program. However, in the absence of a stronger and more coherent national energy policy plan, the nation is at risk of neutralizing any one state's progress because of another state's inability or lack of commitment to participate in an overall national energy scheme. Similar of the need for federal Civil Rights legislation to supersede parochial prejudices within vested interest state decision makers of the 1960s, so too must the federal government play a far more central role in the conceptualization, design, and implementation of a comprehensive national energy policy for purposes of serving the greater good amid an issue of true national and international proportions. Using the Ecological/Strategic energy orientation, several federal energy public works programs should be developed. These programs would promote alternative and conservation forms of energy by making these technologies both affordable and applicable to large segments of our society. The liabilities of oil represent an economic dependency to potentially hostile suppliers, increase the potential of energy wars with the Soviet Union, possess a domestic finite supply, reduce the quality of life by daily industrial and private sources of air pollution, expand the global greenhouse effect, and promote an energy establishment that is motivated by controlling the factors of energy production for purposes of maximum present and future profits irrespective of the liabilities previously noted. Collectively, these new facts of energy justify the argument to transfer energy development and use to a *special public policy* category that will not subjugate national energy policy to a relatively small group of private sector energy industrialists who have been trained to produce and maintain profits at any costs, including but not limited to what could be long-term national energy independence programs realized by the expansion of alternative energy technologies. In effect, a pro-business orientation--defined as any commodity or service motivated by supply and demand--can not be safely applied to

energy development and use until the present liabilities of conventional fuels are removed.

Case by Case Fuel Source Appraisal

An Administration's view of energy will have great impact on which resources receive federal financial and legislative preference. Given this review of the Reagan Administration's National Energy Policy Act, it is clear this Administration promotes the nonrenewable energy camp consisting of oil, natural gas, nuclear, and coal inputs. Renewable resources and conservation measures are not prohibited, although, for all intents and purposes, their potential is comparatively discouraged.

Throughout this overview of the Reagan energy policy, I have raised critical objections along environmental, social, and national security lines. To solve these concerns, a departure from the commodity viewpoint to an Ecological/Strategic view of energy is in order. Naturally, an Ecological/Strategic view of energy promotes a different agenda for the present and transitional fuels of our nation's future. The following pages will present a capsulated case-by-case energy source appraisal based on an Ecological/Strategic standard. Each energy resource is appraised relative to four criteria. They are *environmental impact, sustainability, geopolitical location, and national economic security*. This is an obvious departure from a commodity view of energy whose categories would simply be supply, demand, and price.

Oil

Environmental impact. Oil is a worldwide producer of carbon dioxide that is reducing the quality of air and increasing the greenhouse effect. Its production creates an atmospheric phenomenon trapping sun rays, thereby producing a global climate warming trend. The extent of damage to agricultural-based economies at national and regional levels worldwide has not been calculated. According to scientists, serious economic disasters from droughts may present themselves in the twenty-first century unless daily global carbon dioxide emissions are modified. Recent droughts in the Midwest have been, in part, attributed to warming trends as a result of annual precipitation trends shifting north of their previous histories.

With respect to air pollution, our nation continues to be the largest global producer of carbon dioxide. In fact, the *combined* carbon dioxide emissions of the Western Europe region --to include the United Kingdom, France, West Germany, and Italy--are less than those in our country. Table 3, measuring the carbon dioxide emissions in million metric tons of carbon by country and region (for the years 1950, 1965, and 1983), clearly demonstrates an increasing world trend of carbon dioxide emissions with our nation as the world leading air polluter.

Table 3. Carbon Dioxide Emissions by Country and Region - 1950, 1965, and 1983

Carbon Emissions from Fossil Fuel Consumption															
	1950					1965					1983				
	(million metric tons of carbon)				Percentage of World Total	(million metric tons of carbon)				Percentage of World Total	(million metric tons of carbon)				Percentage of World Total
	Solid	Liquid	Gas	Total		Solid	Liquid	Gas	Total		Solid	Liquid	Gas	Total	
WORLD	1072	385	96	1553	100.0	1484	1118	347	2929	100.0	2017	2028	738	4783	100.0
North America	376	259	88	723	46.6	318	447	238	1003	34.2	432	553	260	1245	26.0
United States	347	245	87	679	43.7	301	406	228	935	31.9	405	500	233	1138	23.8
Canada	29	14	1	44	2.8	17	41	10	68	2.3	27	53	27	107	2.2
Western Europe	336	40	1	377	24.3	358	274	11	643	22.0	272	369	112	753	15.7
United Kingdom	125	11	X	136	8.8	117	52	<1	169	5.8	68	45	28	141	2.9
France	46	9	<1	55	3.5	49	42	3	94	3.2	30	59	14	103	2.2
Germany, Fed Rep	91	2	X	93	6.0	115	56	1	172	5.9	86	68	25	179	3.7
Italy	7	4	<1	11	0.7	8	37	4	49	1.7	12	65	14	91	1.9
Other	66	15	<1	81	5.2	68	87	2	157	5.4	75	131	32	238	5.0
Eastern Europe	250	36	5	291	18.7	495	174	79	748	25.5	609	405	265	1279	26.7
USSR	149	33	3	185	11.9	290	151	68	509	17.4	355	335	221	911	19.0
Poland	30	<1	X	30	1.9	61	4	1	66	2.3	97	11	5	113	2.4
German Dem Rep	43	X	X	43	2.8	79	3	X	82	2.8	64	13	5	82	1.7
Other	28	3	2	33	2.1	66	16	10	92	3.1	93	45	34	172	3.6
Pacific	40	5	X	45	2.9	66	71	1	138	4.7	92	173	22	287	6.0
Japan	26	1	X	27	1.7	45	55	1	101	3.4	61	148	15	224	4.7
Other	14	4	X	18	1.2	21	16	X	37	1.3	31	25	7	63	1.3
Centrally Planned Asia	22	<1	X	22	1.4	134	11	1	146	5.0	403	73	6	482	10.1
China	21	X	X	21	1.4	120	10	1	131	4.5	365	69	6	440	9.2
Other	<1	X	X	X	X	14	2	X	16	0.5	38	4	X	42	0.9
Developing World	48	45	2	95	6.1	93	141	17	251	8.6	209	456	73	738	15.4
Latin America	6	29	1	36	2.3	8	68	11	87	3.0	18	171	35	224	4.7
Africa	19	7	X	26	1.7	34	20	1	55	1.9	66	67	10	143	3.0
Middle East	2	2	X	4	0.3	4	23	2	29	1.0	11	89	16	116	2.4
South and Southeast Asia	20	7	<1	27	1.7	47	29	3	79	2.7	114	129	11	254	5.3

Source: Institute for Energy Analysis, Oak Ridge Associated Universities

X = not available

For additional information, see Sources and Technical Notes

Source: Institute for Energy Analysis, Oak Ridge Associated Universities.

Our nation also leads the emissions of other air pollutants within selected OECD (Organization for Economic Co-operation and Development) nations, including carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter. Figure 4, measuring the emissions of these air pollutants, reveals the commanding percentage for which North America (United States and Canada) is responsible.

Figure 4. Emissions of Air Pollutants in Selected OECD Countries, 1980
Source: *Organization for Economic Co-operation and Development, 1985.*

In effect, the unregulated and continued widespread use of oil represents a real national and global threat to our quality of existence and the future capacity of the world to sustain human life as we know it today. This fact--taken together with our nation as the leading producer of this detrimental process and concurrently a world leader of technological advantages to reverse this trend--places our nation in a unique position of responsibility to begin the change and set the standards in tomorrow's oil-free energy future.

Sustainability. Oil is a finite resource. Once the substance is burned, it is gone except for its largely unusable and environmentally damaging by-products. Figure 5 illustrates the areas of our known oil and gas fields in North America.

Figure 5. Oil and Gas Fields in North America
(million tonnes oil equivalent)

Source: *Energy Resources Atlas*. Total oil and gas reserves 1976--6809mtoe

As of February 1981, the United States has 4% of the world's oil reserves.⁷ However, the "recoverable" reserves places a whole new definition on the term reserves. When the first U.S. oil deposits were drilled, they were like a full sponge. They have been squeezed by conventional means--known as primary and secondary recovery techniques--leaving many existing wells with the expensive tertiary recovery method. To maximize our available domestic reserves will require significantly expanding offshore drilling sites, improvements in recovering oil from currently

producing wells, rapid development of oil shales and tar sands, the liquefaction of coal, and establishing greater oil conservation standards.⁸

The first four provisions carry varying gradations of environmental liabilities while the fifth provision, conservation standards, has undergone a systematic erosion given the last eight years of the Reagan energy policy agenda. Yet, irrespective of the near-term or long-term proposals to enhance oil recovery and use, this resource cannot escape the fact that its supply is exhaustible. For this reason alone, oil as a long-term sustainable resource cannot be deemed a feasible proposition and should be regarded as a (pun intended) "dinosaur fuel."

Geopolitical location. One of the chief liabilities of oil energy is our dependency on an import resource concentrated in a war-torn and politically volatile region of the world--the Middle East. On the other hand, our nation does rank third, after the Soviet Union and Saudi Arabia, among world oil producers.⁹ However, the remainder of the world's oil supply is controlled by the thirteen member nations of the Organization of Petroleum Exporting Countries, who themselves produce half of the world's oil.¹⁰ Figure 6 clearly illustrates our nation's geopolitical vulnerability to oil as the primary input sustaining our economy and popular lifestyle.

This skewed supply and demand relationship between the United States and the Middle East has produced a series of U.S. foreign policy directives having mixed results which, by and large, have had the singular overt or covert goal of preserving our nation's import supply of oil. Results of recent foreign policy include the fall of Iran, the loss of marines in Lebanon, and the Tanker War. The Tanker War in particular presents costly--but currently necessary--measures to keep a fleet of naval vessels deployed in a region that is comparatively far from friendly U.S. waters and supply ports. Three tragedies have resulted from this foreign policy: the loss of life and damage to one of our missile frigates, the downing of an Iranian passenger plane thought to be a hostile Iranian military jet, and the subsequent loss of a civilian commercial jet liner over Scotland via a planted bomb in retribution for the destroyed Iranian commercial jet. All of these tragedies may have been avoided if our nation had pursued energy policies that effectively downgrade our commitment and presence in the Middle East.

Figure 6. World Petroleum Production and Consumption
(million tonnes of oil)

Source: *BP Statistical Review of the World Oil Industry, 1976.*

Simultaneously, our foreign policy directives in the Middle East have been efforts to minimize Soviet influence in the region, and in effect, to have *our oil well* in--geographically speaking--their neighbor's backyard.

At present, both superpowers must carefully conduct their Middle East foreign policy objectives with plenty of escape hatches and face-saving options because neither nation has full control over political developments or decision makers in the Middle East and neither nation can afford a nuclear exchange to solve an impasse. Of course, this is not to say that both military strategists have ignored tactics to survive such an exchange. In short, the geopolitical liabilities of oil derived from the politically volatile and unpredictable Middle East affecting our relations within both the Middle East nations and the Soviet Union clearly demonstrate the importance of beginning national programs to alter our nation's structural dependency on imported oil.

National/economic security. This category has an overlapping relationship to the geopolitical section in that, after a resource is appraised on the merits of its geographic and political landscape, we must consider how this may affect our national security policies that are in turn largely designed to protect our economic vitality. As long as oil continues to maintain its special import status from the Middle East, our nation will be required to subjugate our national security policies to support client regimes that provide oil without full scrutiny of the supplier's form of government, human rights abuses, or their regional relationships with neighboring regimes. This propensity is reinforced in light of our nation's economic dependency on foreign oil suppliers to fuel our energy-intensive economy. This condition therefore exposes our nation to increased unpredictable economic changes via third party foreign decision makers.

In essence, our current economic vitality is too directly tied to the political polarities and potentially hostile relations of the Middle East. Neither economic stability nor by extension our national security interests can be served until imported oil demand can be drastically reduced, if not eliminated.

Conclusion. Oil resources failed overwhelmingly in each category within the Ecological/Strategic view of energy as they possess significant risks at each juncture. As a near-term fuel, oil is undeniably necessary. Our entire society, as well as the Western Democracies and much of the Eastern bloc nations, is structurally dependent on the production and use of oil. Moreover, given our sheer weight of national consumption and our allies' lack of domestic supply (especially Japan and Western Europe), our nation occupies a near "hostage" position to Middle East oil. There are several immediate national programs that should be implemented while long-term solutions are being designed and prepared for consumer and business use. For example:

1. A 20¢ per gallon tax should be levied on all gasoline. This would cause a decrease demand for oil and thereby continue to depress the demand for imported oil.

2. Capital raised from this gasoline tax should finance significant improvements in public transportation, especially within urban and suburban areas. General improvements would address the frequency of bus, train, and light rail route schedules; security for patrons; informational officers; express trains; secondary and tertiary artery systems complementing primary public transportation; streamlining the transfer between various modes of public transportation; and the maintenance of warm, comfortable, and clean way-stations.
3. A percentage of this same tax would also be applied to research and development on alternative renewable resources for individual and industry use. For example, our nation is inseparably tied to a maze of local, intrastate, interstate, and national roadways for private cars. Cars do not have to be abandoned, but their dependency on oil should be reduced. Electrical cars with auxiliary gas engines should, as a first phase, be designed, developed, and introduced nationwide. Private sector interests may receive tax incentives, nominal interest on federal loans, and other financial incentive to invest and assume ownership of as much of this new market as they wish. From these early prototypes, refinements in design may yield electrical cars with greater power, range, creature comfort, sophistication, and supplemental fuel sources, including solar panels and wind generators fed by their own movement along the roadways. The possibilities for private transportation--independent of oil as a primary fuel--are many with the overall net effect of our nation's reducing air pollution and enabling our public official leaders to pursue national security goals that do not become subservient to the interests of preserving foreign oil supplies. Figure 7 displays the Copper Electric Town Car built by the Copper Development Association. This car has a range of 120 miles at a top speed of 55 miles per hour and a 75 mile range in stop-and-go city driving with energy costs estimated between 2¢ and 3¢ a mile! Table 4 notes the advantages and disadvantages of electric automobiles. Industry, scientists, and R&D at the federal level may solve the weight, range, and costs of current battery systems storing electricity.

Figure 7. Copper Electric Town Car
Source: *The World Energy Book*.

Table 4. Advantages and Disadvantages of Electric Vehicle

<i>Advantages</i>	<i>Disadvantages</i>
Quiet Motor	Limited Range of Batteries
Easy to Operate	Current High Cost of Batteries
No Pollution (At the Auto)	Limited Top Speed
Smooth Acceleration	

Source: *The World Energy Book*.

4. Efficiency standards for new cars and appliances should be rigorously applied and their compliance enforced. Collectively, these gains will add to the national efforts at making our finite fuels go farther and lowering our foreign demand, thereby minimizing the incentive for Middle East and U.S. oil rate hikes. Figure 8 clearly illustrates the need to promote efficiency standards for new cars because the bulk of our oil use is converted to gasoline to fuel our private vehicles.

Figure 8. How U.S. Uses Oil
Source: *The World Energy Book.*

In general, we cannot escape overnight--or even at best over the next two decades--our heavy commitment of oil to fuel our industries and propel our private vehicles. Yet, we can begin the transitional process of disengaging from the dependency of oil through a gasoline tax, improvements in public transportation, the mass introduction of private electrical vehicles, and efficiency standards applied to the existing mixture of private vehicles and appliance uses. These examples represent but a small percentage of the possible alternatives to reducing our nation's overall need for oil as a primary fuel and beginning to put the nation back in control of its foreign policy pronouncements, including stabilizing democracies and Middle East relations.

Natural gas

Environmental impact. Compared to the by-products of oil use, natural gas is a clean fuel source. However, much environmental debate has risen over the merits of more drill sites to tap "unconventional sources of natural gas" which, until recently, have not been considered viable due to the cost of finding and drilling these resources. The unconventional natural gases are derived from four principal areas:

devonian shale, coal seams, tight sands, and geopressed zones.¹¹ For example, tight sands are found in concrete-hard geologic formations that underlie many regions of the country.¹² To tap their natural gas supply, the formations must be fractured underground by injection of high-pressure fluids to allow larger quantities of gas to reach the well bore. What environmental effects the large scale production of natural gas from tight sands deposits and the other three candidate sources may cause are still unclear and remain to be seen.

Sustainability. Natural gas supplies 26% of the nation's energy needs.¹³ Each year we consume twenty trillion cubic feet (TCF) and for years production has outstripped discoveries of new reserves, leading many experts to consider gas a slowly dwindling resource. Conversely, with the decontrol of prices, an increase in gas exploration has revealed vast new gas fields in the Rocky Mountain region and the Gulf Coast of Louisiana, though their potential is still undetermined.¹⁴ In the final analysis, natural gas, like oil, is a nonrenewable resource. As our conventional supply is consumed, increased efforts to harvest a largely untapped unconventional supply may prevail. These efforts will cost more to find and drill, which will increase the price of natural gas for all consumers, especially if consumers have not been prepared to finance the capital costs associated with shifting to another fuel source and/or using this existing fuel more efficiently. Also, as noted above, the increased drilling efforts to recover unconventional natural gas supplies may carry unforeseen environmental by-products whose scrutiny may be less than desirable in an energy crisis. Figure 9 indicates the world natural gas production and consumption. We are the world's largest producer of natural gas but our consumption exceeds our own supply. In fact, our singular consumption is greater than the combined regions of Western Europe, Africa, China, Eastern Europe, and the Soviet Union at 485 mtoe (million tonnes oil equivalent) to our 516 mtoe.

Geopolitical location. A positive aspect of natural gas is its geopolitical location. Our nation has 8% of the world's gas reserves, double the amount of our domestic oil supply.¹⁵ Our neighbors, Canada and Mexico, make up an additional 5% of the world's supply.¹⁶ Given our comparatively lesser rate of demand (to that of oil) and greater rate of domestic supply, natural gas enjoys opposite conditions of oil and is therefore a far more preferred near-term energy resource. However as Figure 10

displays, the Soviet Union and the Middle East enjoy a comparative supply advantage of natural gas reserves. Yet this apparent geopolitical disparities--at least for the Soviet Union--is counterbalanced by the logistical complication and associated costs of having their supply located in harsh remote Siberian regions far from their population centers.

Figure 9. World Natural Gas Production and Consumption
(million tonnes oil equivalent)

Source: *BP Statistical Review of the World Oil Industry 1976.*

Figure 10. World Natural Gas Reserves and Trade Movements
(million tonnes oil equivalent)

Source: *BP Statistical Review of the World Oil Industry 1976*.

National/economic security. Our economy is not heavily based on the immediate production, conversion, and use of natural gas. Furthermore, we are not importers of natural gas and consequently our national security concerns are almost nonexistent when compared with oil resources. Granted, the nation is not completely insulated from some unknown source causing an energy loss of natural gas, but our domestic supply and consumption keeps such a risk at a comfortable and adjustable margin.

Conclusion. Natural gas contains both assets and liabilities within the Ecological/Strategic formula. On the upside, the dispersed concentrations of natural gas, our present domestic supply, and our economy not being heavily based on its use, satisfy geopolitical and national/economic security categories. On the negative side, the potential environmental costs from the production of unconventional natural gas and its finite nature overall fails to satisfy the environmental impact and sustainability categories.

As a near-term fuel, that is until other forms of energy can substitute for the current nonrenewable energy supplies, natural gas provides an excellent supplemental energy source. More state and federal legislation should be composed to optimize the life of natural gas when used for home heating and other applications. This may provide the lead time necessary to implement an energy transition with as few business and lifestyle disruptions as possible.

Coal

Environmental impact. All fossil fuels affect the environment to some extent, but the impacts of coal production and use are potentially the most serious. Coal possess two significant environmental liabilities: carbon dioxide (adding to the greenhouse effect) and acid rain. To a lesser but recognized degree, strip mining involves careful reclamation planning to restore, as near as possible, the effect of surface mining. Unfortunately, surface (opencast) mining's share of total production has grown in recent years.¹⁷

The increases in coal consumption traditionally embodied in long-term energy projections are big enough to lead to major climate modifications.¹⁸ At present the only known way of avoiding a warmer earth and rising sea levels is not to burn the coal in the first place. With respect to acid rain, coal combustion emits large quantities of nitrogen oxides (thought to be a key contributor to acid deposition) in addition to sulfur dioxide, soot, ash, and dust as well as heavy metals (the amounts depend on the quality of coal burned).¹⁹ The effect of these emissions produce the acidification of lakes, damage to buildings and metal surfaces, reduced crop yields, and forest declines.²⁰ For example, it is estimated that the financial losses arising from forest decline in West Germany amount to more than \$1 billion per year.²¹ It is possible to eliminate most sulfur dioxide emissions from coal-fired power stations by installing flue gas desulfurization systems. In addition, new less-polluting technologies, such as fluidized bed combustion, may also help alleviate acid deposition problems.²² However, several countries (e.g., the United Kingdom, United States, Czechoslovakia, and Poland) have not retrofitted these systems into existing plants because they feel that the benefits would not justify the costs.²³ The commodity approach to energy development and use would naturally measure an energy application or related

technological modification based on a cost-benefit analysis. Here is a clear example of the worst excesses and gross neglect that energy industrialists can exact upon the environment and the quality of existence for all Americans. The energy business community (especially coal and nuclear industrialists) must factor-in the costs associated with environmental systems added to their production processes for purposes of responding to the real global threat of the greenhouse effect, acid rain, and radioactive waste. We can not however expect this collective of investors to modify their behavior unless clear and pronounced economic penalties and incentives are legislated at the federal level of government. In other words, make it more *cost effective* to employ environmental systems rather than face monetary fines or not capitalize on time-bound tax credits or low-interest loans for the installation of environmental systems. Again, since the business of energy industrialists is both profit and the preservation of consumer demand for their product, it is understandable why this community is not interested in raising the cost of their product by passing on the expenditures necessary to make their industry environmentally responsible. Simply put, they are not in the business of environmental standards, especially if it negatively impacts their capacity to generate revenues and expand their operations. Given this realistic view of what motivates most businesses (which incidentally is fine except for the fact that the business of energy affects the environment for all concerned) and in the absence of future legislation that is designed to utilize present day environmental systems technology (subject to change where these systems can be improved upon), all that will be said is that history will hold responsible this Administration's narrow commodity view of energy while the next generation will inherit the reduced quality of existence and the defrayed maintenance costs to solve the pollution fallout that could have been significantly reduced and in some areas eliminated. Figure 11 illustrates the distribution of acidity of rain over the United States and Canada as of 1982.

Figure 11. Distribution of Acidity of Rain Over the United States and Canada, 1982

Source: *National Acid Precipitation Assessment Program (NAPAP), 1984.*

Final note: the bulk of our U.S. coal reserves (52%) is of the bituminous rank which is high in heat but also high in sulfur.¹⁷ Only 2% of our coal reserves--of the anthracite rank--possess the ideal formula of high heat and low sulfur.¹⁸ Unless or until this industry can produce more advanced filtering appliances to reduce its carbon dioxide and acidic emissions, coal should not be pursued as one of the nation's primary fuel source. The potential of coal is great, but the costs, given its current environmental impact, are greater still.

Sustainability. Coal, found around the globe, is concentrated in the United States, the Soviet Union, and China.¹⁹ Of this concentration, we enjoy the largest share--more than a quarter of the world's known reserves. Although coal is a fossil fuel and therefore finite, it is a plentiful fuel that would last the world more than 200 years at present rates of consumption, and these projections are regarded as conservative estimates.²⁰ Coal is not a renewable resource, but where environmental systems can be installed, coal should be regarded as a near-term fuel, given its undeniable domestic supply. Table 5 documents the world's proven coal reserves in billions of tons.

Table 5. The World's Proven Coal Reserves
(in billions of tons)

U.S.S.R. and other Communist Nations	305
United States	216
Western Europe	72
Far East and Oceania	46
Africa	17
Other	<u>9</u>
TOTAL	665

Source: *The World Energy Book.*

Geopolitical location. As noted, the majority of the known coal reserves is within our national borders. Moreover, coal deposits are spread amongst our ally nation states. Finally, there has been a "thawing" of relations between our traditional 1950s adversaries--the Soviet Union and the People's Republic of China. No single

region or nation state has a monopoly control on coal reserves, and the regions that do have a greater share of coal reserves do not appear as vulnerable to the comparative political and military turmoil of the Middle East. Figure 12 illustrates the world coal reserves and trade movements.

Geopolitically speaking, coal has an encouraging disbursement of reserves keeping our nation fairly well insulated from foreign events affecting our present use or supply of coal. Table 6 notes the estimated coal resources in the United States.

Table 6. U.S. Estimated Coal Resources

<i>Depth of Overburden (Feet)</i>	<i>Type</i>	<i>Resources (Billions of Tons)</i>	<i>Energy Reserve (X 10¹⁸ Bru)</i>
100	Strip Coal	140	3.6
100 to 3,000	Bituminous	959	37.0
	Lignite	448	
	Anthracite	13	
3,000 to 6,000	All Types	337	8.8
6,000 to 9,000	All Types	<u>1,313</u>	<u>34.1</u>
		3 710	83.5

Source: *The World Energy Book*.

National/economic security. National security concerns are satisfied because of our overwhelming domestic supply and the international distribution of coal throughout the world. Similarly, since we enjoy a large percentage of known coal reserves and because coal is not the backbone of our energy-intensive economy, coal satisfies the economic security part of this category. Unfortunately, coal does present some economic unknowns: it is a labor intensive industry subject to strikes, which may significantly decrease productivity. Also the costs to improve the transportation of coal will be heavy, given the existing limited rail facilities if coal is called upon to represent a greater percentage of our current energy mix.

Figure 12. World Coal Reserves and Trade Movements
 (million tonnes oil equivalent)
 Source: *World Energy Conference Survey of Energy Resources, 1974.*

Conclusion. Coal represents a mixed bag of liabilities and assets. Clearly, coal satisfies the Geopolitical and National/Economic Security concerns because of its widespread global distribution and our large domestic supply. Moreover, the use of coal to fuel our economy represents only a fifth of the energy we consume each year.²¹ This comparatively small percentage of the energy mix would promote coal's expanded use without jeopardizing our nation's national security by becoming dependent on a singular resource base to run our economy.

Conversely, coal has been described as an "abundant resource with abundant problems."²² Environmentally, the national use of coal will cause more air pollution, promote the global greenhouse effect, and increase the frequency and intensity of acid rain nationwide. This presents unacceptable costs to our quality of existence and our agricultural economy. To a lesser degree, coal is a liability, given its nonrenewable recoverable supply and therefore should not be regarded as a long-term fuel source. Until more advanced technology can convert coal to produce high heat with low and treatable sulfuric emissions, coal cannot be regarded as a member of an Ecological/Strategic energy program.

As a near-term fuel, coal is presently here to stay. As a supplemental future fuel, coal may play a limited role. Yet the greatest threat from coal comes from its excellent political position for massive national use should a severe energy crisis face our nation today or even a decade from now. In a national energy crunch, a climate of urgency and expediency would promote the use of coal's undeniable domestic supply as a national fuel source to meet the nation's immediate energy needs, independent of whatever technological deficiencies may exist in the filtering process of sulfur emissions into the atmosphere. In effect, the ability to design and build long-term energy solutions--bearing both quantity of supply and consumer quality of existence--may be deemed a "luxury" ill afforded in the context of an energy crisis.

Nuclear

Environmental impact. The operation phase, transportation, and storage of spent uranium pellets present irreversible radioactive contamination risks. Despite this fact, our nation maintains the greatest number of operable reactors, has the most installed capacity, and likely the largest spent fuel inventories at 11,382 cumulative metric tons of heavy metals as of 1984. Table 7 denotes the world nuclear power capacity and waste generation comparing 1970 to 1984 totals.

In addition, the breeder reactor (favored by the Reagan Administration for purposes of multiplying our reactor fuel supply at least seventy-fold) converts uranium to plutonium, of which only a few pounds are necessary to construct a powerful nuclear bomb. This presents an additional threat to the environment because of the greater likelihood of nuclear weapons proliferation, particularly if obtained by organizations or nation states hostile to our interests.

Our nuclear energy industry will refute the environmental risks of nuclear technology, given an almost flawless safety record of "known" equipment failures. However, the nature of their fuel source presents irreversible environmental consequences. Ironically, if faced with the choice of two super tankers dumping their full cargo load of crude oil into San Francisco Bay as compared with one fifty-gallon drum containing a handful of spent uranium pellets, the choice is obvious: the former is treatable and survivable, the latter is irreversible and takes no prisoners.

Sustainability. Nuclear energy provides 15% of our current energy mix.²³ Uranium is a nonrenewable resource but this fact is canceled by the intensity and subsequent energy longevity a small amount can produce. For example, a pound of enriched fuel contains nearly three million times the energy in a pound of coal.²⁴ We enjoy more than a quarter of the world's uranium supply, primarily in New Mexico and Wyoming.²⁵ Estimates suggest our domestic supply of uranium could support all 56 reactors now operating, plus the additional 39 under construction, for each of their 30-year life spans.²⁶ Figure 13 displays the world nuclear power production and installed capacity.

Table 7. Nuclear Power Capacity and Waste Generation, 1970-1984

	Number of Operable Reactors		Installed Capacity (GWe)		Nuclear as Percent of Total Electricity Generation		Spent Fuel Inventories (cumulative metric tons of heavy metal)	
	1970	1984	1970	1984	1973	1984	1970	1984
WORLD TOTAL	80	345	16.8	226.6			8403	88854
MARKET ECONOMIES	65	285	18.2	196.7			8000	34238
Europe	46	133	8.8	84.4				
Belgium	1	5	0.0	3.5	0	51		
Finland	0	4	0.0	2.3	0	42		
France	5	41	1.6	33.3	8	59		
Germany, Fed Rep	4	16	0.9	16.1	4	28		
Italy	3	3	0.6	1.3	2	4		
Netherlands	1	2	0.1	0.5	2	6		
Spain	1	7	0.2	4.8	3	19		
Sweden	1	11	0.0	8.4	3	41		
Switzerland	1	5	0.4	2.9	16	37		
United Kingdom	27	38	4.8	10.7	10	17		
Yugoslavia	0	1	0.0	0.6	0	8		
North America	19	103	5.4	81.2			331	17748
Canada	1	17	0.2	10.0	6	12	98	8363
United States	15	88	5.2	71.2	4	13	235	11382
Far East	3	38	0.8	27.8			14	3670
Japan	3	31	0.8	21.8	2	23		
Korea, Rep	0	3	0.0	1.8	0	22		
Taiwan	0	5	0.0	4.0	0	48		
Other	2	10	0.4	3.8			0	1083
Argentina	0	2	0.0	0.9	0	11		
Brazil	0	1	0.0	0.6	0	0		
India	2	5	0.4	1.0	4	3		
Pakistan	0	1	0.0	0.1	0	4		
South Africa	0	1	0.0	0.9	0	0		
NON-MARKET ECONOMIES	15	50	1.6	29.9			X	X
Bulgaria	0	4	0.0	1.6	0	32		
Czechoslovakia	0	3	0.0	1.3	0	8		
German Dem Rep	0	5	0.0	1.8	0	12		
Hungary	0	2	0.0	0.9	0	10		
USSR	15	48	1.6	24.1	1	8		

0 = zero or less than one-half the unit of measure; X = not available.

Source: *Nuclear Engineering International*, U.S. Department of Energy.

Figure 13. World Nuclear Power Production and Installed Capacity
Source: *UN Statistical Yearbook, 1975*.

In terms of sustainability, we possess a creditable supply of the necessary inputs and clearly enjoy the greatest (or in the top 3) amounts of nuclear power production and installed capacity. The question remains, is nuclear energy the best solution for our present and future energy needs?

Geopolitical location. Nuclear energy does not present a geopolitical risk because no single region dominates its supply. North America has 41% of the global uranium reserves with a distribution of 12% in Canada, .3% in Mexico, and the remaining 29% within our borders.²⁷ Presently we remain the world leader of nuclear power capacity and the number of operational nuclear plants. Table 8 notes our commanding lead in gigawatts capacity and number of plants for both 1974 and 1980.

Table 8. Gigawatts Capacity and Number of Nuclear Plants

<i>Nation</i>	<i>1974</i>		<i>1980</i>	
	<i>Capacity (Gigawatts)</i>	<i>Number of Plants</i>	<i>Capacity (Gigawatts)</i>	<i>Number of Plants</i>
U.S.	38.0	58	85	100
USSR	2.6	9	15	25
Japan	3.1	7	32	40
Canada	2.5	6	7.5	13
Great Britain	5.6	14	12	19
France	2.8	11	15.0	23
W. Germany	2.3	11	20	30
WORLD TOTAL	57.0	134	200	450

Note: A plant may contain one or more reactors.

Source: *The World Energy Book*.

National/economic security. Similar to coal's position, nuclear energy also enjoys a relative "green light" along National/Economic Security lines. Presently, our economy is not closely aligned with nuclear energy to support our economy, and we enjoy a respectable percentage of the known uranium reserves.

Beyond the obvious military applications, nuclear energy remains primarily sidelined to our utilities market. Within this capacity, only two states are becoming heavily committed to nuclear electricity with Vermont at 80% and Maine at 60% of their

respective electricity supplies.²⁸ However, nuclear energy plants do present economic concerns that will likely be passed on to consumers and--given the financial pattern of the Reagan Administration--subsidized by the federal government. Rising plant costs, conservation efforts, and increased health and environmental concerns by the nation's populace is making nuclear energy more expensive to produce. The costs associated with the elaborate precautions required during plant construction, operation, and disposal of spent pellets--combined with a slackened energy demand--has dropped reactor orders.²⁹ The real fear comes from a pure entrepreneurial mentality gaining access to the final decision making process of a given plant that may downgrade operational and disposal safeguards for purposes of making a plant more cost effective and therefore more competitive in the energy marketplace. This is precisely why a commodity viewpoint--particularly in the nuclear energy sector--is extremely inappropriate and presents irreversible and disastrous environmental ramifications. The recent oil spill of the tanker *Exxon Valdez* may have been minimized had the double hulls associated with other tankers been instituted during the construction phase of the ship. For cost effective purposes, this procedure was not utilized and therefore has contributed to the largest oil spill in U.S. history.

Conclusion. From an Ecological/Strategic view of energy, nuclear technology satisfies three of four criteria. Unfortunately, the degree of unacceptable risks in one area, the environment, outweigh the degree of benefits nuclear energy enjoys within the sustainability, geopolitical location, and national/economic security categories.

For purposes of minimizing the accumulation and management of nuclear waste, nuclear energy should be limited to military applications, space vehicles, and continued research and development on ways and means to make this tremendous energy source environmentally acceptable. In the meantime, the existing active commercial nuclear plants should be selectively taken off-line by 60% with sufficient capacity to generate plutonium for military requirements and emergency electricity in a national crisis. Moreover, military nuclear generating plants should operate under the same rigorous safety standards applied to civilian nuclear sites. The significant dropped ratio of American's favoring the building of new nuclear power plants after the Three Mile Island plant accident may suggest the electorate's willingness to take a long, hard

look at either expanding or continuing our nuclear development practices. Figure 14 graphs the marked change in our people's faith in nuclear safe technology when asked if they favored or opposed the building of new nuclear power plants in March of 1975 and again in 1979 after Three Mile Island. The ABC News-Harris Survey asked the U.S. population the question "Do you favor or oppose the building of new nuclear power plants in the U.S.?" In March 1975, 63% favored and 19% opposed new plants. However, after the Three-Mile Island plant accident, the ration dropped to 47% to 45%.

Figure 14. Public Opinion Change Before and After the Three Mile Island Accident
Source: *Fortune*, September 10th, 1979.

Admittedly, nuclear energy is here to stay; the genie has been let out of the bottle. However, given the limitations in today's technology which is unable to render nuclear energy's radioactive byproduct harmless to man, nuclear energy should be "contained" to a narrow national role.

Solar power

Environmental impact. Sun rays drench the earth with vital solar energy that keeps this planet habitable. Although sun rays contain radioactive elements, our atmosphere protects us from these harmful effects. Solar power is not only environmentally benign, but it is essential for all known life forms. Our only real threat from solar rays has been man made by the use of fluorocarbon products, which thin the atmosphere at both the North and South Poles. There have been international conferences on the effects and controls necessary to stem this process, but no international moratorium on the use of fluorocarbons has been secured.

Sustainability. Each year the sun inundates the United States with 500 times more energy than we consume.³⁰ If the nation could tap one tenth of that, the entire U.S. energy demand could be met with the rays' striking just 2% of the nation's surface.³¹ The sun is the most sustainable energy resource we have; in fact, by heating the earth and its atmosphere, the sun is also the creator of wind and wave power and provides rainfall for rivers, which supports our hydroelectricity capacity.

Geopolitical location. No single region or nation controls the sun supply. Granted, there are regional differences in the distribution of the nation's average hours of sunshine. The western states and Miami enjoy between 20,000 to 24,000 kilojoules of solar energy *per square meter* as compared with the rest of the nation at 12,000 to 16,000 kilojoules of solar energy per square meter.³² It takes about 55,000 kilojoules to heat water for a family of four for a day.³³ Even at the low end, 12,000 kilojoules per square meter--whether in the state of Maine or Wisconsin--provide a respectable amount of energy even at 50% utilization. As noted in the sustainability category, the entire nation's energy needs could be met with the rays' striking only 2% of our national surface at only a tenth utilization of the solar rays received each year.

Concerns over regional disadvantages are academic given the amount of untapped solar energy available in the comparatively colder areas of the nation. The real challenge is financial support and implementing a national solar energy program. Figure 15 denotes the average annual distribution of solar radiation and location of the greatest solar sites.

•• There are many experimental solar furnaces in operation worldwide but their combined generating capacity is far less than that of the Odeillo plant.

Figure 15. Average Annual Distribution of Solar Radiation and Location of the Greatest Solar Sites*

Source: *Energy Resources Atlas*.

National/economic security. Solar energy could provide a long overdue boost in our national security by reducing our commitments in the Middle East morass via the reduction of our foreign oil demand. Solar energy has unlimited energy potential for heating our homes, supplementing our industry energy needs, and removing oil as a "primary" fuel to feed our private vehicles. These plausible changes will obviously not transpire overnight or indeed, even over the next two decades. Yet our nation's national security options--in an energy crisis--may be far wiser and less militarily committed if our decision makers are operating within a transitional environment (towards renewable energy technologies), as compared with a crisis management environment given today's potential for a nonrenewable energy shortage and persisting dependency.

With respect to our economic security, an entire new industry could be unleashed employing large numbers of the populace in the sales, construction, installation, and maintenance of new solar energy technologies. At a minimum, as private home consumers gain full ownership of their solar energy equipment, this reduced energy cost will provide more disposable income for helping to keep the consumer economy active and healthy. At the best case scenario, the average lower-middle and middle-class income (\$25,000 to \$40,000 annual income) people may actually be able to save and invest respectable amounts of money from their current "wage earner" condition. Amid these three possible positive developments, an additional windfall exists simply from Americans' spending a greater share of energy dollars within our domestic economy rather than overseas.

Conclusion. Solar energy clearly meets all four Ecological/Strategic criteria. I had previously viewed solar energy as just one of several renewable energy systems limited to a "supplemental" role within our national energy mix. However, given the astounding large quantities of solar energy lavished each year within our borders alone (500 times more energy than we consume), I now foresee solar energy as becoming one of the principal resources in our national energy mix provided both Congress and the Executive branch can muster the leadership and courage to promote this and other future technologies that do not serve the interest of the present nonrenewable energy industrialists.

Geothermal power

Environmental impact. There are three primary geothermal energy methods, each of which harnesses the Earth's heat. The most common method is tapping the energy that comes from hot springs. This hot water is used to heat homes and is also used for industrial processing. In Boise, Idaho, hot springs have heated homes since the 1890s while in California's Imperial Valley, steps to produce electrical power with hot water are projected to create 200 megawatts.³⁴ The second geothermal method is converting energy out of the phenomenon of geysers--the venting of the Earth's heat in the form of dry steam with high pressure but low water content. For example, such steam-driven turbines at the geysers in California produce electricity equal to half of San Francisco's consumption.³⁵ The third method is creating energy out of hot dry rock. Water pumped down into hot dry rock circulates through fractures picking up heat for recovery at the surface. The first two methods are natural phenomena that have not presented known environmental risks since their earliest first known recorded observations. The third method, pumping water into hot dry rock, does not presently present known environmental dangers. However, one consideration to keep in mind is that Earth heat results from the radioactive decay of rocks.³⁶ The degree of danger is the "radioactive granite intrusions" by water may still remain to be seen and should be examined carefully before large scale production sites are brought on line.

Sustainability. Geothermal energy represents one of our most plentiful resources. Just a fraction of this source equals the energy in all U.S. coal reserves.³⁷ Experts estimate that thirty-two million quads of energy are simmering within ten kilometers of the surface of the United States.³⁸ Its sustainability appears limitless as the Earth undergoes its natural internal heating and venting processes. However, the greatest abundance of geothermal sources is hot rock, which also represents the greatest difficulty to utilize. Table 9 denotes four types of geothermal sources and their relative abundance and ease of utilization.

Table 9. Four Types of Geothermal Sources

<i>Type/Characteristic</i>	<i>Dry Steam</i>	<i>Wet Steam</i>	<i>Hot Brine</i>	<i>Hot Rock</i>
Ease of Utilization	Highest (Greatest Ease)	Somewhat Difficult	Difficult	Greatest Difficulty
Abundance	Lowest	Somewhat Abundant	Abundant	Great Abundance
Drilling Depth	8,000 Ft. (2,440m)	3,000 Ft. (915m)	4,500 Ft. (1,370m)	10,000 Ft. (3,050m)
Pressure and Temperature of Steam or Water	7 Atmospheres 200°C	2 Atmospheres 230°C	1 Atmosphere 240°C	400°C
Currently Operating Fields	Larderello, Italy Geysers, USA Matsukawa, Japan	Wairakei, New Zealand Cerro Prieto, Mexico	None	None
Exploration Sites		Kilauea Volcano, Hawaii	Imperial Valley, Calif.	Marysville, Montana

Source: *Energy Resources Atlas*.

Geopolitical location. As with solar energy, no one nation or region controls the bulk of the Earth's geothermal energy potential. Domestically, areas within a high heat gradient--primarily the West and Eastern seaboard--stand to benefit most from geothermal energy.³⁹ Yet the potential energy available from these regions will likely produce a surplus of electricity that can be supplied to the rest of the nation where needed. Figure 16 displays the areas of global potential for geothermal exploitation and operational plants on dry steam and hot water fields.

* The figures listed are approximate figures, by comparison a large modern fossil-fueled power station has a generating capacity of 1000 MW

Figure 16. Global Potential for Geothermal Exploitation and Operational Plants
Source: *Energy Resources Atlas*.

National/economic security. Renewable energy resources display a common thread in this category because they represent *domestic* sources of energy for our economy and way of life. Similar to the positive developments of solar energy, geothermal energy provides another domestic resource that can lower our military overseas energy commitments and serve to keep the exchange of U.S. energy dollars within our domestic economy.

Conclusion. The potential for tapping the Earth's heat is promising, especially from the hot water and geysers methods. Environmental concerns from extracting heat by the dry hot-rock method should be reviewed closely before long range facilities are constructed and made operational. The amount of potential geothermal energy is also surprising. However, given its far more regional nature than solar energy and its required centralization at a "harvesting" site, geothermal energy will not likely become one of the nation's principal energy resources but nonetheless can play a convincing support role in the nation's future energy mix.

Wind power

Environmental impact. As noted in the solar energy section, the kinetic energy of the wind is solar energy.⁴⁰ In effect, air motion moves because of uneven heating of the surface of the Earth. Since the Earth's surface is not uniform, incoming solar energy is received and radiated in different ways. On a global scale, the combination of our Earth's rotation and differential heating create great planetary circulation patterns.⁴¹ From an environmental perspective, harnessing wind power presents an ideal resource for generating energy without any negative environmental by-products. However, there are esthetic, noise, and land use considerations, and at the "household" level use, the operator will need to exercise caution and environmental safeguards in the construction and maintenance of a storage building to house batteries. Several batteries used for storing energy do present combustible risks and acidic concentrations that need to be managed wisely. In contrast, the management of nuclear waste sites or the carbon dioxide by-product of fossil fuels dwarf the environmental risks of a battery storage building.

Sustainability. Thanks to the heat of the sun and our planet's rotation, wind power is guaranteed. Conversely, because of the differing dispersion of this heat by land, water, and geographic location, wind power does not present a constant energy source but is a fluctuating power source. Nevertheless, the power potential of wind is considerable. At 10 miles per hour, the air passing through a single square foot of area carries the energy equivalent of 10 watts of electricity.⁴² The two primary variables in sustaining wind power lie in seasonal and national fluctuating wind patterns themselves and the wind energy conversion systems (WECS) used to generate electricity. Yet these variables are worth working with given the amount of sustainable domestic wind potential. Figure 17 illustrates our annual average wind power available, in watts per square meter.

Of the nation's more than 3.6 million square miles, about 1.6 million experience acceptable average winds.⁴³ Most of that land lies west of a line drawn from Grand Fold, North Dakota, to Dallas, Texas. The remainder is concentrated in the northeast, midsouth, West Coast, Hawaiian, and Caribbean areas. With terrain, land use, and local population factored in, the actual area available for wind machines drops to about 214,000 square miles.⁴⁴ However, this presents ample land to deploy 800 "Mod 2" wind machines, the largest wind machines now being tested by NASA and the DOE (this number is based on turbines spaced at 1500 foot intervals).⁴⁵ The rated output for the Mod 2 is 2.5 megawatts. With maximum deployment of wind turbines, wind power has the potential to produce electricity equal to the amount now being produced by hydroelectric plants--approximately 13% of our national electricity generated.⁴⁶

Figure 17. Annual Average Wind Power
(in watts per square meter)
Source: *The Wind Power Book*.

Geopolitical location. Wind, the offspring of solar energy, also enjoys relatively few geopolitical constraints. No one nation state can control or dominate its source or factors of production. Granted, there are differing global rates and duration differences of wind power, but from a domestic perspective, our national borders enjoy a respectable amount of convertible wind energy that does not present gross disparities with the remainder of the international community. If anything, our nation's comparative financial and technological advantages represent our capacity to set the international standards on the viability and utility of wind energy. Table 10 notes that we currently enjoy the collection of largest wind power generators in the world.

Table 10. Wind Power Generators in the World

<i>Name and Location</i>	<i>Electric Power Rating (kW)</i>	<i>Swept Circle Diameter (Feet)</i>
Smith-Putnam (1941) Vermont, USA	1,250	175
Gedser (1957) Denmark	200	79
NASA-Lewis (1975) Ohio, USA	100	124
NASA (1978) Clayton, New Mexico	200	125
Tvind (1978) Denmark	2,000	178
NASA (1979) Boone, North Carolina	2,000	200

Source: *World Resources Atlas*.

National/economic security. Both areas are satisfied completely: first, wind power--at only 50% projected utilization--can play a support role in helping to alleviate our dependency on unpredictable and potentially hostile foreign oil suppliers. This will diffuse our propensity to regard any alteration of oil supply as a national security risk. For certainly, given our existing level of dependency (especially where oil is regarded in "commodity" terms), any significant change in the flow of foreign oil represents an economic threat, and hence, a national security threat. In addition, the

nation's economy can never be threatened by the national maximum development of wind power because this renewable resource, on its own, can support the present day energy demands. Therefore, our economy will not be subject to the "changing winds" of energy supply although, to some economists, that characterization may not be far from the mark, given our current energy mix and resulting overseas dependence. In either case, the use of wind power on a national scale must begin with the federal uniformity of income tax credits or deductions for wind power equipment purchases and use. As shown by Figure 15, this prerequisite remains unequal given 24 states do not participate in these financial incentives.

Conclusion. Wind power represents a model alternative to many of the current nonrenewable resources used to generate electricity, principally, coal and nuclear energy. There is no debate that the contribution of wind power to national industry will be limited to a support role. Yet, the combination of solar, geothermal, and wind power may represent a strong statistical energy producing alternative to coal and nuclear processes. These renewable resources, supplemented by water power and conservation measures, collectively may yield sufficient *and* surplus electricity for national use. Figures 16 and 17 show the Smith-Putnam wind machine and the offshore wind power machines as promoted by Professor William Heronemus.

Figure 15. Income Tax Credits or Deductions for Wind Power Equipment by State
■ (the shaded states offer income tax credits or deductions)

Source: *The Wind Power Book*.

The Smith-Putnam Wind Machine on Grandpa's Knob in Vermont was built by Palmer Putnam. The two-blade propeller was 175 feet from tip to tip. Each blade weighed 8 tons and consisted of stainless steel. The machine was rated to produce 1,250 kilowatts. The machine was actuated on August 29, 1941, and operated usefully for two years. A bearing failed in 1943 and, since World War II was in progress and this project had low priority, it took several years to obtain a new main bearing. The new bearing was installed early in 1945. Following the installation, the machine was operated only a few months when one blade failed due to overstress after being idle for two years. The machine was subsequently dismantled. The project had cost 1.25 million dollars. The concept was that, if several similar machines could be produced by Smith-Putnam that the cost could be reduced to \$200 per kilowatt for construction.

Figure 16. Smith-Putnam Wind Machine

Source: *The Wind Power Book*.

Professor William Heronemus has proposed a system of offshore wind-power machines. The offshore system places three rows of wind stations across the prevailing westerlies in the Gulf of Maine-Georges Bank area of the continental shelf. Each wind machine has a capacity of 2 megawatts, and 3 wind machines are mounted on each station mounted on floating platforms near the 100-meter depth contour. Wind stations are clustered around an electrolyzer plant to yield hydrogen stored in a collector. There are 2,000 such wind platforms totaling to 12×10^6 kilowatts. The average wind speed at towers of 100 feet would be 20 miles/hour. A 200-foot diameter wind machine with three sets of such units mounted on each platform is proposed. The total project is estimated to cost 22 billion dollars.

Figure 17. Offshore Wind Power Machines

Source: *The Wind Power Book*.

Water power

Environmental impact. Water power has four primary forms: hydro, tidal, wave, and thermal. Hydroelectricity is the use of dams and water pipes to direct a flow of water that turns electricity-generating turbines. Tidal power produces electricity by capturing the ebb and flow of coastal tidal ranges relative to their geographic position and the gravitational pull of the sun and moon. Wave power, still in the infant research stage, may capture the energy in waves reaching the shore while thermal water power is the energy that can be produced by the different temperatures of water in the ocean.

Water power is practically free of environmental hazards. There is, of course, a local environmental impact in the construction and installation of hydroelectric, tidal, and sea thermal electricity-producing facilities. However, any kind of private or commercial development will have a local environmental impact. Yet the use of water power, when compared with fossil fuel technology presents one of the best methods to produce energy as regards economy, efficiency, cleanliness, reliability, and inexhaustibility.⁴⁷ Fossil and nuclear plants convert raw materials into heat causing air and water pollution. Water power adds no heat to the air or to the water and does not contribute any pollutants. Table 11 presents a comparison of the characteristics of electrical energy sources between conventional fossil-fuel, steam electric, and nuclear fission reactors to that of hydroelectric plants.

**Table 11. A Comparison of Characteristics of Electrical Energy Sources
-between-
Fossil-fuel, Steam Electric, Hydroelectric, and Nuclear Fission**

Conventional Fossil-fuel Steam Electric

1. Air and Thermal Pollution (60% Heat Rejection)
2. Best Location Near Fuel Source and Cooling Water
3. Large World Reserves Available
4. Technology Well Developed and Proven
5. Relatively High Operating Cost

Hydroelectric Power Plants

1. Clean, Non-polluting and No Heat Rejection
2. Environmental Impact is Dam and Reservoir
3. Only Available Where Suitable Sites Exist
4. Largely Already Exploited in Industrialized Countries
5. Technology Well Developed and Proven
6. Very Small Operating Cost, While High Capital Cost per kW
7. 50 to 100 Year Economic Life

Nuclear Fission Reactors

1. Thermal Pollution (75% Heat Rejection)
2. High Capital Costs (Higher than Fossil Plants and Lower than Hydro)
3. Technology Available
4. Safety and Environmental Effects Not Proven

Source: *Energy Resources Atlas*.

In both the fossil and nuclear electrical generating systems there are air and thermal pollution with 60% and 75% heat rejection respectively. Hydroelectric power plants produce energy that is clean, nonpolluting and with no heat rejection. Conversely, hydroplants may present harmful environmental and social side effects. For example, the displacement of indigenous people from their traditional lands, often to poorer ones: 80,000 were displaced by the Awsan High Dam in Egypt, and 75,000 by the Lake Volta scheme in Ghana ⁴⁸ Other effects include the spread of waterborne diseases such as schistosomiasis, the disruption of aquatic ecosystems, and major reductions in the flow of nutrient-rich silt to agricultural lands downstream which depend upon the silt for their fertility.⁴⁹ These types of environmental and social effects in the United States may not present as acute examples as those noted above but, nonetheless, will have to be closely considered if the expansion of hydropower plants is to be pursued within our national borders.

Sustainability. Water, covering three-fourths of our planet, presents an inexhaustible energy potential. The sun guarantees the Earth's hydrologic cycle involving the evaporation, precipitation, and runoff of water. This process helps feed the hydroelectricity method and may someday produce a fifth source of water power: tapping the energy of precipitation falling through the air.

Each water power method has high, although differing degrees, of sustainability. Hydropower is sustained by both the hydrologic cycle--which provides an upper elevation water supply to recycle through water turbines--and the pumped-storage system. The pumped-storage system takes a percentage of the electricity produced by the hydroelectric plant to operate water pumps that refill water back into the hydroelectric lake from where it began. Both systems maintain a level of fuel sustainability for hydroelectric power. In addition, it has been estimated that the world's hydropower resources alone equal the 1970 total world consumption of fossil fuel energy--a potential capacity of about three million megawatts.⁵⁰ Hydroelectricity is a highly sustainable and plentiful energy source, but the fixed nature of a hydroelectric site presents capacity limitations. Within our domestic borders, we have already made use of the most attractive hydroelectric power sites.⁵¹ Other sites are available, but their relative remoteness presents large investments in the construction of dams and the maintenance of transmission lines. However, increased federal investment in the tidal and thermal forms of water power may preclude the need for developing several new, and more expensive, hydroelectric plants. Figure 18 denotes the world hydroelectric production and installed capacity with plant locations.

Figure 18. World Hydroelectric Production and Installed Capacity with Plant Locations
Source: *UN World Energy Supplies 1971-1975*.

Tidal water power involves the construction of *tidal mills* that draw on a complex energy system using the rotation of the Earth and the gravitational pull of sun and moon. Figure 19 demonstrates the way tidal mills generate electricity.

Tidal power is obtained from the oscillatory flow of water in the filling and emptying of partially-enclosed coastal basins during the semidiurnal rise and fall of the oceanic tides. This energy may be partially converted into tidal-electric power by enclosing such basins with dams to create a difference in water level between the ocean and the basin, and then using the water flow while the basin is filling or emptying to drive hydraulic turbines propelling electric generators. Shown in the figure is the cycle of the tides and the generation of electrical power using a two-way flow scheme. The dotted line is the level of the water in the basin and the solid line is the level of the sea.

Figure 19. How Tidal Mills Generate Electricity

Source: *World Resources Atlas*.

Like hydroplants, tidal mills also present capacity limitations because there are only a few places that permit the practical and economic use of tidal power. On the other hand, tidal power is praised for its consistency in contrast with the flood and drought sometimes associated with rivers tapped for hydro power. With tidal mills, there is no need to flood a large area of land to create the necessary head of power production as in hydro power.

Similar to hydro power, the current use of tidal power is far below its potential global capacity. Currently, two noteworthy tidal mills are located in France and the Soviet Union. The French tidal mill is situated on the estuary of the River Rance near Saint-Malo. The Rance River site yields 350 megawatts of electricity each day, which represent a 600 million kilowatt capacity annually.⁵¹ In the Soviet Union, the Keslaya Guba plant, located 600 miles north of Murmansk, produces 400 kilowatts

annually.⁵² These tidal mills represent an impressive example of capacity and consistency but are modest demonstrations when compared with the potential output sites located on the Cook Inlet of Alaska, the gulf of Argentina, or Canada's Bay of Fundy. The Alaska site could produce an estimated 75 billion kilowatt-hours a year, about 7% of total U.S. electric power use in 1970.⁵³ The Gulf of Argentina, an area of 780 square miles, experiences 30-foot tides to yield a 12 billion kilowatt hours per year-four times the capacity of the Rance River project in France.⁵⁴ Finally, a tidal mill site at Canada's Bay of Fundy could produce an annual energy output of 7,560 million kilowatt hours to save an estimated 10.1 million barrels of oil a year.⁵⁵ Lack of capital and the current affordable cost of electricity has been two reasons for not investing and moving forward with the development of these tidal power sites. If all three sites were made operational, the Americas would possess a significant new electric capacity whose fuel is inexhaustible, consistent, and *clean*. This development, supplemented by other hydro and thermal water power sites, may produce a combined electric capacity to challenge the U.S. nuclear industry's assets and highlight its liabilities with respect to the cost of nuclear power plants and the management of spent nuclear fuel. Figure 20 notes the existing, probable, and possible world tidal energy sites. Table 12 identifies the characteristics of some of the leading tidal power sites located world wide.

Figure 20. World Tidal Energy Sites
Source: *World Resources Atlas*.

Table 12. Characteristics of Tidal Power Sites

Site	Tidal Range, R (Meters)	Basin Area A (km ²)	P _{actual} (Megawatts)	Barrage Length, L (Meters)	L/A (m/km ²)	L/P _{actual} (m/megwts.)
Rance, France	11.4	22.0	160	725	33	4.5
Brest, France	6.4	92.0	211	3,640	40	17.3
Chausey, France	12.4	610.0	5,252	23,500	39	4.5
Savern, Britain	11.5	50.0	370	3,500	70	9.5
Passamaquoddy, USA	7.5	120.0	378	4,270	36	11.3
Bay of Fundy, Cobequid, Canada	11	700	4,743	8,000	11.4	1.7
Kislogrub, USSR	4	2	1.8	30.5	15	16.9

Tidal range R = difference in amplitude between high and low tides.

P_{actual} = actual power output

Barrage = the dam across the opening of the bay.

Source: *World Resources Atlas*.

The concept of wave power is still in its infancy stage of research and development. There have been some creative designs to tap the power of waves, but to date, no present design produces creditable amounts of electricity for private or consumer use. Undoubtedly, the sustainability of wave power is very high, but converting this motion into mass forms of energy remains to be seen. Figure 21 identifies the potential wave energy sites in specific sea areas.

Figure 21. Annual Wave Energy in Specific Sea Areas
Source: *Energy Resources Atlas*.

Thermal water power, more commonly referred to as Sea Thermal Energy (STE), or Ocean Thermal Energy (OTE), presents a highly sustainable, clean, and inexhaustible energy resource. STE has a 24 hour capability because it does not depend on the sun shining or the wind blowing; instead, STE is tapping the solar heat stored over time in the sea.

STE is not a new idea but has undergone several stages of development. The idea of tapping solar power stored in the sea was first identified in 1881 by French scientist Jacques d'Arsonval.⁵⁶ The basic idea utilizes the temperature differences of the sea between the cooler, deeper, and denser water to that of the solar energy stored water near the surface. For optimal energy conversion there is a constant reservoir of chilled water lying under the warm tropical subtropical oceans. This area is known as the *thermal difference belt* located between the latitudes 20 degrees north and 20 degrees south where a 30 degree Fahrenheit temperature difference between warm and cold sea water is constant. Figure 22 shows the possible global locations for Ocean Thermal Energy.

--- Mean surface temperature at 25°C.
 ▴ Attempted site
 ▽ Proposed site.

Figure 22. Possible Locations for Ocean Thermal Energy
 Source: *Energy Resources Atlas*.

Among the many developments STE has undergone, two principal energy conversion plants are the floating Anderson STE plant design, and the Lockheed OTEC plant. The Anderson STE plant was designed to produce 100 megawatts of power per day. It is a large ocean going barge anchored offshore. Three hundred feet below the surface, large, ocean warmed boilers would heat propane to drive turbines and produce electric power. Above the boilers, equally sizable condensers would cool the propane with cold water piped from a depth of 2,000 feet. The Anderson STE would consume an inexhaustible fuel supply and not pollute the atmosphere or ocean. In fact, beyond the electricity produced by the Anderson STE plant, several beneficial by-products are produced. First, the recovery of valuable minerals, chemicals, and materials used for fertilizers could be recovered from the sea water that run the turbines. Second, fresh water could be produced by modifying the condenser section of the STE plant. This 100-megawatt pilot unit would produce 800 million gallons of fresh water per day using one half the power produced by the plant. The cost of this fresh water, piped 40 miles to shore, would be less than four cents per 1,000 gallons for 800 million gallons a day.⁵⁷ Third, the STE produces a miniature upwelling of the colder sea water, which possesses an abundance of nitrates, phosphates, and silicates that act as the nutrients to support the life processes that fish feed on. Naturally, these nutrients will attract fish and other marine creatures to create profitable fishing grounds for commercial fleets. Finally, oxygen is a cheap by-product of the water desalting process.

The Lockheed OTEC plant uses four power modules attached to a central platform with mooring attachments capable of anchoring in 20,000 feet of water. The unit is equipped with a cold water intake pipe, 1,000 feet long. Electricity is transmitted to shore by cable in the form of direct current, to a maximum of 80 miles. As alternatives to electricity, the OTEC plant would have the capability of producing gaseous or liquid hydrogen, metallic hydrides, ammonia, or other forms of stored energy that could be transported ashore for use as needed.⁵⁸ The plant would be constructed of slip-form concrete. Water would be moved through the power modules at a rate of 28 cubic feet per second. Where this plant operates in equatorial waters, the per-kilowatt costs would be as low as \$350 dollars, half that of a nuclear plant.⁵⁹

Both the Anderson and Lockheed OTEC plants are highly sustainable because as heat is removed from the ocean, more incoming solar energy will be absorbed by the ocean. In affect, the fuel source is inexhaustible and consistent.

Geopolitical location. Like solar and wind power, water power is not dominated by any single region or nation. Areas for hydro and tidal power are limited by geographic requirements; however, both power sources are currently underutilized. The hydro global potential capacity is about 3 million megawatts of which Africa has 780,000 megawatts and South America has 577,000 megawatts.⁶⁰ The worldwide use of hydroelectricity power totals less than 250,000 megawatts, roughly 8% of potential capacity.⁶¹ Table 13 identifies hydropower development status by region as of 1982.

There are several strategic locations for STE plants. There are 11 countries adjacent to the Indian Ocean, 15 to the Pacific, and 29 around the Atlantic. Within these 55 countries, 10 nations are only one mile from a suitable STE source.⁶² Only a half dozen are 70 or more miles distant from a suitable site. In essence, STE plants offer a global energy resource. Closer to home, STE site locations include Puerto Rico with temperature differences of about 40 degrees Fahrenheit. Other sites include the Gulf Stream of Texas, Miami, Florida, the Atlantic seaboard, and areas within the Gulf of Mexico.

National/economic security. The development of water power will enhance our national security by offering another alternative energy source beyond the unpredictable and often hostile oil supplier states of OPEC and other Third World foreign supplier regimes. Any move lowering our commitment and dependency to this region bolsters our capacity to free-up and redirect our finite amount of defense personnel and technology for other national security purposes as required. In addition, our economic security is enhanced as our energy-intensive economy begins to transfer away from an oil foundation and move to a new mixture of technologies that are less regional, concentrated, and can be domestically tapped.

Table 13. Hydropower Development Status by Region, 1982

	Actual Technical Potential	West Africa	East Africa	South Asia	East Asia	Europe Middle East North Africa	Latin America Caribbean	100-Country Total
Potential Production (barnwall-hours)								
Installed	14	45	60	78	76	221	494	
Under Construction	9	37	47	72	48	165	378	
Under Investigation	48	85	90	790	47	563	1,623	
Remaining	301	826	528	1,752	186	1,716	5,307	
Total	372	993	723	2,692	357	2,665	7,802	
Capacity (barnwall-hours)								
Installed capacity	3	9	14	26	19	51	122	
Under Construction	2	8	12	17	16	38	93	
Under Investigation	10	17	21	155	15	126	344	
Remaining	70	182	124	356	50	335	1,117	
Total	85	216	171	554	100	550	1,676	

Source: The World Bank, 1984.

Given our First World technological and capital advantages over the Third World regimes, we are in a unique position to develop water power systems both domestically and internationally. By developing water power systems in the Third World, we stand to create another profit source and--through a joint ownership leading to a majority of shares buy-out program--we begin to help the Third World to become more energy self-sufficient with the hope of creating a more stable economy and thereby a more loyal and stable political ally. In addition, as the ownership of power plants are assumed by the host nation state, their government achieves a new revenue source to repay both energy and other consumer infrastructure investments financed by our government and private investors.

Conclusion. Water power completely satisfies all four Ecologic/Strategic categories. It is a power source that is environmentally clean, and does not consume precious national resources that are finite and may be used for other purposes. Beyond the initial investment of a hydro, tidal, or sea thermal site, the fuel is free because of the inexhaustibility of water. This presents a highly sustainable fuel source, especially with respect to tidal and STE methods, given their consistency of output.

Although hydroelectric sites and tidal mills present rigid geographic and capacity limitations, their potentials, and their more flexible sea thermal power cousin, are vastly underutilized. Water power may never play a significant role in our future national energy mix; nonetheless, its potential may provide an appreciable new source of electricity --both domestically and internationally. The combined operations of solar, geothermal, wind, and now water power, would raise the viability of substituting, in-part or in whole, new sources for U.S. electricity as compared with our present mix of nuclear and coal resources.

Conservation

Environmental impact. Conservation measures take two primary forms--technical and social.⁶³ The technical aspects of conservation either improve or replace existing technology to deliver a more energy efficient operation. For example, tuning the engine of a four-door Lincoln Continental will improve the fuel efficiency whereas replacing the Lincoln with a Honda Civic will deliver even more fuel efficiency. Social forms of conservation involve behavioral more than technical change. Turning off unnecessary lights, slowing to fifty-five miles on the highway, participating in carpools, and using public transportation are some social forms of conservation.

In either form, conservation measures are highly environmentally benign because they improve or conserve an energy application and thereby lower the negative environmental by-products. The absence of conservation measures does not produce more goods or services. In addition, the more energy efficient our society becomes, both technically and socially, the less likely the construction of new energy facilities can be economically or politically justified. Therefore, conservation measures lower the environmental impact associated with the initial extraction phase of energy development--specifically, the expansion of strip mining for coal, the proliferation of platform oil rigs along the West Coast, or the construction of additional commercial nuclear plants. Naturally, an energy producer has a conflicting orientation with respect to conservation and development:⁶⁴

From the viewpoint of the energy producers, investments in growth have substantial advantage over investments in conservation: new facilities produce a tangible product. Although the same amount of money invested in conserving energy would often save more energy than can be produced by investments in new facilities, this conserved energy (which would otherwise be wasted) is energy that has already been counted by the producers as sold. The energy company and the stockholders, for whom a dollar earned is a dollar earned, are generally unenthusiastic about returned merchandise.

In effect, energy producers drawn from the oil, coal, gas, and nuclear industries are not in the business of lowering the demand for their product via conservation measures and logically cannot be regarded as the "private incentive" best suited to develop a balanced national energy plan. In the absence of stronger conservation measures, more energy will have to be consumed to keep our economy active and our standard of living high. Consequently, more environmental pollution will impact our air, water, and land. Table 14 measures the areal extent and cost of control that specific pollutants present to our environment. Note how our air, water, and land is affected by the pollutants created from conventional forms of energy.

Interesting to note--oil spills in the "water" section of Table 14 are noted to possess regional or local impact. The cost of control is said to be low. Compared with the potential clean-up costs of a major oil spill by a super tanker, certain preventative measures would be far less expensive to provide. For example, double hull construction, a 24-hour "oil skimmer" vessel and crew on stand-by and/or escorting the tanker to a three-mile limit offshore, qualified pilots aboard the vessel when operating in confined waters, requiring all ship's personnel to be aboard four hours prior to getting underway to ensure they are not "chemically" impaired to perform their respective duties, and setting new underway orders for ships' captains to view local weather conditions as "company preferred" decisions to delay arrival times rather than meet their shoreside schedules. Without these safeguards, we are exposing our coastal and inland waters to serious environmental risks.

The recent oil spill of the *Exxon Valdez* in the pristine waters of the Pacific Northwest highlights the ramifications if these types of environmental safeguards are ignored. In each item above, they failed miserably. Exxon reported the hull as double sided but the manufacturing yard alerted the media that the decision to build a double-hull vessel was changed to a single hull given the increased cost of providing two hulls. The "oil skimmer" vessel was indeed purchased, but at the time of the oil spill, the small craft was removed from service (hailed out) and placed in dry dock for purposes of annual maintenance to the underbody of the vessel. No secondary vessel was on stand-by and Exxon, as required by law, did not notify the proper authorities that the "skimmer" would be temporarily pulled from service. The individual manning the conn was not endorsed to act as a pilot for the waters being navigated but instead was the

ship's 3rd Mate. The captain was not on the bridge during an area of confined and ice laden waters when he should have been--but given the preliminary alcohol tests, he may have been too "chemically" altered to perform his duties anyway. Finally, the pressure of a shoreside schedule to "deliver the goods" can impair the decision making of a ship's captain with respect to a safe speed in confined and reduced visibility waters for the simple purpose of being kept in a favorable eye by the shoreside administration who may affect his employment status. By not incorporating these safeguards, Exxon is relearning the old adage--a penny wise is a pound foolish. However, even though Exxon is currently paying out several thousands of dollars for their clean-up efforts, these expenditures may be regarded as a business loss and therefore the actual economic penalty to Exxon may be far less than overtly presented. Until the gap between instituting operating safeguards and the cost of clean-ups is made economically significant, then the commitment of Exxon and any other national or foreign tankers to adopt such measures will be comparatively less likely.

Table 14. Environmental Factors Related to Energy

Environmental element affected	Type of impact	Pollutant	Areal extent			Cost of control		
			Global	Regional	Local	High	Intermediate	Low
Air	Chemical-physical	Carbon dioxide	■					
		Carbon monoxide		■	■	■		
		Sulfur oxides		■	■	■	■	
		Nitrogen oxides		■	■	■	■	
Hydrocarbons			■	■	■	■		
Photochemical smog			■	■	■	■		
Particulates		■	■	■	■	■	■	
	Water vapor	■	■	■	■	■	■	
	Trace metals		■	■			■	
	Radiological	Noble gases	■					■
	Particulates		■	■			■	
	Resource use	Oxygen		■				■
	Helium		■				■	
	Other	Thermal inputs		■	■	■		■
		Electromagnetic emissions		■	■	■		■
	Noise		■	■	■		■	
	Chemical-physical	Oil spills		■	■	■		■
		Acid mine drainage		■	■	■		■
	Water	Radiological	Tritium	■	■	■		
Other effluents				■	■			■
Uranium milling wastes			■	■			■	
Thermal		Thermal inputs		■	■	■		■
Land	Chemical-physical	Acid fallout from the air		■	■	■		■
		Mineral fallout from cooling towers		■	■			■
		Solid wastes			■	■		
	Radiological	High-level wastes		■	■			■
	Resource use	Land subsidence		■	■			■
		Strip-mining of coal		■	■			■
		Land use for power production and transmission		■	■			■
		Hydroelectric dams		■	■			■

Costs: High – greater than \$1 billion per year.
Intermediate – \$10⁶ < cost < \$10⁹ per year.
Low – Less than \$1 million per year.

Source: *Energy Resources Atlas*.

Sustainability. Conservation is highly sustainable because its resource value is applied to improvements, replacements, or social changes within a multitude of our societal energy uses. To lower the energy required to heat a home, run a vehicle, activate a water heater, operate a refrigerator, illuminate an office, or make public transportation more attractive to our business and middle-class population are some representative samples of the many diversified areas conservation measures may deliver their resource value. For example, Table 15 outlines a set of objectives for energy conservation for the United States in 1985.

Table 15. A Set of Objectives for Energy Conservation for the United States in 1985

<i>Item</i>	<i>Annual Energy Saving (Quad = 10¹⁵ Btu)</i>
1. Use of Wastes for Recycling and Energy Generation	2.0
2. Electric Conversion and Transmission Efficiency Improvement	0.5
3. Use of Waste Heat from Electric Plants for District Heating	1.0
4. Efficiency Labelling and Efficiency Improvement for Appliances and Room Air Conditioners	0.5
5. All New Automobiles with at Least 22 Miles per Gallon Average	2.0
6. Industrial Energy Efficiency Improvement	3.0
7. Conservation in Building, Heating and Cooling	2.0
8. Revision of Peak Load Pricing Schemes for Electric Utilities	1.0
TOTAL	12.0

Source: *Energy Resources Atlas*.

With respect to uses of wastes for recycling and energy generation, Table 16 identifies the energy savings from recycling materials in the United States as compared to the total electrical energy use in 1975.

Table 16. Energy Savings From Recycling Materials in the United States

<i>Material</i>	<i>kWh Saved/Ton of Recycled Material</i>	<i>Estimated Total Savings if All Material was Recycled (kWh)</i>
Paper	4,210	50×10^9
Steel for Autos	7,000	100×10^9
Aluminum Beverage Cans	49,000	7.2×10^9
Steel Beverage Cans	7,000	34×10^9
TOTAL		191.2×10^9
Total Electrical Energy Use in the U.S. in 1975		$1,900 \times 10^9$

Source: *Energy Resources Atlas*.

Reducing our energy consumption in the production of virgin steel, paper, aluminum, and glass, also delivers the added bonus of lowering the industrial pollution associated with these industries. In addition, the problem of storing our municipal waste can be reduced by recycling organic waste material (biomass) and thereby deliver oil, methanol, ethanol, and biogas. Table 17 notes the methods for converting organic wastes or biomass to synthetic fuels consisting of heavy oil, oil and lower energy gas, and methane gas. Table 18 shows the advantages and disadvantages in the production of methanol, ethanol, and biogas.

Table 17. Methods For Converting Biomass to Synthetic Fuels

<i>Method</i>	<i>Process</i>	<i>Product</i>	<i>Characteristics</i>
Hydrogenation	Conversion of Cellulose	Heavy Oil with an Oxygen Content of 10%	Relatively Expensive
Pyrolysis	Thermal Decomposition in the Absence of Oxygen	Oil and Lower Energy Gas	Reasonably Priced, Plant Operating in Baltimore
Anaerobic Digestion	Digestion of Wastes	Methane Gas	Similar to Sewage Treatment Plant

Source: *Energy Resources Atlas*.

Table 18. Alternative Fuels From Biomass

<i>Fuel</i>	<i>Product</i>	<i>Advantages</i>	<i>Disadvantages</i>
Methanol (Methyl Alcohol)	CH_3OH	Cost similar to gasoline. Can be used in 10% blend with gasoline for autos.	Distribution, risk of separation in the blend
Ethanol (Ethyl Alcohol)	$\text{C}_2\text{H}_5\text{OH}$	Can be used in gasoline blends up to 10% ethanol. Ethanol has 80,000 Btu/gallon.	Two times as expensive as gasoline (1979).
Biogas	Low Btu Gas, Methane	Clean Burning	Need to modify engines to use.

Biomass is any organic agricultural product. Gasohol is a mixture of 10% ethanol and 90% gasoline.

Source: *Energy Resources Atlas*.

Recently, President Bush announced his support for the increased consumer use of methanol in cars. This represents a notable but small conversion in our use of fossil fuels because methanol is mixed with gasoline up to a 10% blend. Even so, every effort to reduce our foreign oil demand and reduce our municipal waste accumulation is beneficial for most Americans.

The sustainability of conservation is also highlighted by table 19 noting the four primary areas of residential, industry, transportation and commercial building near term savings of energy as a percent total for that item.

Table 19. Energy Conservation Schemes

	<i>Potential Near Term Savings as Percent of Total for that Item</i>
Residential	
a. Insulation (homes)	5%
b. Air Conditioning	1%
c. Lighting, Appliances	5%
d. Solar Heating	5%
Industry	
a. Process Steam	5-10%
b. Recycling of Materials	3%
c. Total Energy Scheme	5-10%
Transportation	
a. Mass Transit for 10% of Urban Passenger-Miles	2- 5%
b. Smaller, More Efficient Autos	3- 5%
c. Shift Some Freight and Passengers to Trains	1- 2%
Commercial	
a. Air Conditioning	2%
b. Solar Heating	5%
c. Building Design	3%

Source: *Energy Resources Atlas*.

Consequently, given the many forms conservation measures may take, no single or specialized group of resources are required to ensure the longevity of conservation measures and hence its sustainability is high. In fact, until (or if) a fuel source is discovered that is clean, abundant, light, and transferable for many uses, the effort to design improvements, substitutions, or behavioral changes for advancing man's condition and his machines guarantees a constant impetus for conservation's sustainability.

Geopolitical location. As noted by the Reagan Administration's national energy policy plan, "conservation has shown itself to be a unique, economic, and highly flexible energy resource applicable to all energy technologies and fuel types. It is not limited by geography or indigenous natural resources, and it may offer significant environmental advantages."⁶⁵ Similar to the wind and solar technologies, conservation measures are also comparatively exempt from any one region's or nation's dominating its potential. This fact reinforces the attractiveness of conservation becoming a more active member in a future energy-mix policy.

National/economic security. Most economists, historians, political scientists, philosophers, and public officials would agree that a nation's economic goals will affect its national security agenda. Japan, under our post-World War II assistance, has recognized that it can achieve its pre-World War II economic goals and more without the previous generation's militaristic national security agenda. Similarly, our national security can be less threatened when national conservation measures are implemented to reduce the risk associated with unpredictable overseas supplies that support our economy. In essence, when our economic activity can be healthy, relatively secure, and promising, our national security is simultaneously strengthened. Therefore, the use of conservation measures can deliver both economic and national security dividends.

Two misconceptions about conservation measures must be dispelled. First, lowering our energy demand will not reduce our economic prosperity. The opposite is true. Second, reducing our energy consumption does not lower our standard of living. On the contrary, such reforms can only improve our existence, at less cost. For example, many legislators argued that economic growth required ever increasing amounts of energy and that without it the United States would falter.⁶⁶ Advocates of conservation were often labeled "no growthers." On the contrary, energy analysts found that slower energy growth did not result in reduced economic growth. In fact, a National Academy of Sciences study completed in 1980 noted that as energy prices rise, the nation will face important losses in economic growth if we do not significantly increase the economy's energy efficiency.⁶⁷ In effect, the relationship between increases in energy consumption and growth in the gross national product are not linear.

With respect to conservation affecting our standard of living, energy analysts noted that the United States can use 30% to 40% less energy than it does with virtually no penalty for the way Americans live.⁶⁸ Instead of conservation measures requiring assumed sacrifices, such reforms can sustain and improve our standard of living at less cost.

Conclusion. Conservation measures should be regarded as an important energy resource whose collection of separate programs and activities can reinforce and complement each other to achieve a significant contribution towards an energy efficient and secure America. The benefits of conservation measures include lowering our energy demand while still achieving economic prosperity and a high standard of living; decreasing our oil imports thereby increasing our national security and international stability; and decreasing our demand for conventional domestic energy production (oil, coal, and nuclear technologies) to enhance our domestic environmental goals and release capital for other forms of economic investment and growth.

There are two approaches to implementing conservation programs: economic incentives or economic penalties. Examples of some economic incentives involve tax credits or low cost loans for homeowners and businessmen. Economic penalties would be gas taxes or higher bridge tolls. Politically, legislators are typically more interested in presenting economic incentive legislation rather than penalty laws because the electorate is more receptive to a carrot than a stick approach. In either case, if conservation measures are ever going to yield an identifiable contribution, the benefits from economic legislation and the costs to the consumer through penalty legislation should be intensified across the board.

As an example of the myriad of programs aimed at improving our conservation record, the following is a list of congressional conservation efforts between 1973 and 1980:⁶⁹

- Provided aid to states for weatherproofing schools, hospitals, and dwellings occupied for low-income families.
- Directed states to develop conservation plans.
- Required minimum energy efficiency standards for automobiles, major home appliances, and new buildings.
- State utility commissions revised rate structures to encourage

conservation (i.e., higher rates during peak hours and ended the practice of lower prices for larger volume users).

- Required utilities to promote residential conservation.
- Provided subsidies for loans to persons installing conservation equipment.
- Provided business and residential tax credits for conservation.
- Established mandatory thermal efficiency standards and insulation requirements for new and remodeled buildings.
- Required mandatory lighting efficiency standards.
- Encouraged carpools and public transportation.
- Directed utilities to buy electricity from co-generators (generating electricity from their industrial heat) and other energy producers (solar, wind, current, etc.).

In all of the above programs there is room for intensification for awards and penalties. For example, presently a home owner may receive a tax credit of only 15% for the first \$2,000 he expends on home insulation.⁷⁰ This means a tax credit of \$300. Moreover, he can only achieve a maximum credit of \$300 no matter how much more he needs to spend beyond his initial \$2,000. The tax credit is too low and there should not be an imposed maximum. As the law is currently drafted, only a small number of well-off homeowners can afford to invest in insulation improvements and such modifications are limited in scope because homeowners are penalized for spending more than \$2,000. Instead, to encourage a wider breadth of participation drawn from our society, the insulation material tax credit should be 40% with either no ceiling or a ceiling applied to individuals or joint incomes exceeding \$60,000 per year. Moreover, low interest loans and grants--at both the state and federal level--should be available to supply the capital for the insulation improvements. In effect, there should be low interest loans for those

below the \$60,000 annual income bracket, higher interest loans for those above, and grants for those at or near the national poverty line. Grant recipients of course, would not be eligible for any tax credits.

The existing legislation is out-of-touch with the average margin of disposable income Americans possess, given today's skyrocketing cost to become a homeowner and simply the lesser but equally taxing cost of living. Unless a combination of low interest loans (or grants) and larger tax credits is offered, the scale of national participation for home insulation will be far lower than its potential. As noted in Figure 23, space heating and air conditioning comprise the second and third largest uses of electricity in an average United States household in 1970 as a percentage of the total energy use. Also note that the appliances of refrigerators and water heaters makeup the first (at 18%) and tie for the second (at 16%) largest uses of electricity in an average United States household for the same period. Improved legislation that financially promotes widespread insulation practices and energy efficiency standards for several household appliances (particularly refrigerators and water heaters) could yield significant reductions in our demand for foreign and domestic energy needs.

Figure 23. The Uses of Electricity In An Average Household in 1970

Source: *Energy Resources Atlas*.

In addition, the promise of reducing the energy to operate an office building is clearly apparent in Figure 24--which took a typical 126,000 square foot office building in Manchester, New Hampshire and yielded a 34% reduction in space heating through the use of floor insulation, wall insulation, roof insulation, reduced window area, double glazed windows, and a lower aspect ratio.

Figure 24. Household Energy Conservation Schemes via insulation

Source: G. Dallaire, "Designing Energy-Conserving Buildings," *Civil Engineering*.

In addition, Figure 25 displays how an additional 16% of energy can be cut through improved lighting and heating, ventilation, and air conditioning systems. The Manchester building cost about 10% more but will consume about one-half as much energy as a typical building.

Figure 25. Household Energy Conservation Schemes via improved system designs
Source: G. Dallaire, "Designing Energy-Conserving Buildings," *Civil Engineering*.

Of course, as noted earlier, our energy suppliers are not in the business of lowering the demand for their product especially if this affects their ability to generate income. Here again reinforces this author's concern at the Reagan Administration's emphasis placed on "industry" and the "marketplace" to create and promote the best possible energy solutions for today and the future.

Carpools and public transportation are other conservation measures capable of significantly lowering our overseas energy commitments, but lacking the intensity of effort. For example, the Bay Area could improve its conservation efforts dramatically because public transportation is a natural solution when the area has forced population density because the inland bay of San Francisco creates community concentrations along its water borders. However, in order for the Bay Area Rapid Transit (BART) to be successful, it must meet several improvements, the least of which include:

- BART must circle the entire Bay Area, including replacing or running alongside the Cal Train system.
- BART should connect with both the last stop of the existing Cal Train station and the Trans Bay Terminal (congregation point of the San Francisco, East Bay, and Marin bus line systems).
- Security, information officers, and public parking escorts all need to be added to the service sector of BART's operation.
- The BART stations need to be kept cleaner and provide comfortable and warm way stations.
- The express system should be a standard feature, i.e., stopping at every other station.
- One form of ticket should be applicable for all interrelated public transportation systems.
- Conductors should be employed to monitor underway activity within the BART carriers themselves acting as both security and information officers.

All of these changes are designed to make public transportation more convenient and attractive to the business and middle-class populations of the Bay Area.

Currently, except for peak commuter hours, the bulk of individuals using public transportation remain the poor and student populations.

Carpooling could also be more attractive if several changes are instituted, some of which include:

- Increasing the length and number of carpool lanes, including a two person traffic lane and a three or more persons traffic lane
- Increasing the time frame of carpool hours to reflect realistic commuting hours which are not 7:00 A.M. to 9:00 A.M. or 4:00 P.M. to 6:00 P.M. but rather 6:00 A.M. to 10:00 A.M. and 3:00 P.M. to 7:00 P.M.
- Raise the rate of all bridge tolls 100% to finance public transportation improvements and act as an incentive to carpool or use public transportation
- Increase the tax credit percentage from 10% for company vans to 35% based on the price of the van or other vehicle used to transport company employees

There are also energy efficient improvements in the area of appliances that deserve attention, but as noted in the introduction, the Reagan Administration has blocked energy efficient legislation because they perceived such actions as undue federal intervention into the private sector. Meanwhile, appliances without energy efficient improvements such as furnaces, air-conditioners, water heaters, and refrigerator appliances account for 20% of the nation's energy consumption.⁷¹

Overall, conservation as a source of energy remains a grossly neglected element in our national energy mix. Its unpopularity and obstructionist elements stem from many quarters: the interests of car manufactures, highway builders and maintenance firms; domestic energy suppliers, particularly within the oil and nuclear technologies; an uninformed and economically unmotivated consumer population with

regard to improving energy efficiencies for appliances, transportation, and housing systems; and an ideologically conservative Reagan Administration assuming a pro-business orientation by blocking energy efficient legislation to consumer items in order to keep the price-per-unit competitive to achieve a bottom line sales objective while characterizing such veto action because such legislation represents undue federal intervention into the marketplace.

Some may regard energy conservation, even if fully implemented, as only delivering a modest contribution for our nation's energy needs. In reality, all our wasted energy in cars, homes, commercial buildings, and factories is greater than the total amount of our oil imports.⁷² The dividends of conservation measures should be apparent but the commitment and resources to implement more intensified efforts remain diffused and comparatively symbolic.

Conclusion

We are an energy-intensive society. We are also a world leader and an industrialized nation whose life blood is dependent on finite and unpredictable resources to feed our economy. This has impacted and, for the present, will continue to impact adversely the latitude of our foreign policy options with respect to rewarding regimes that are pro-democratic or penalizing regimes that may be both anti-democratic in general and anti-United States in particular. In effect, our ability to implement foreign policies that promote and maintain democratic regimes can become "idealistic" priorities in our environment of energy expediency, especially amid a perceived or real energy crisis. In addition, the primary energy resources consumed to keep our society affluent produce serious global environmental damage and, with respect to the current nuclear technology, present a potentially irreversible ecological disaster.

My interest and research in our nation's energy policy is motivated by the interrelated triad involving our energy-intensive society, our resultant lowered foreign policy options, and the global environmental damage caused by conventional fuel processes. In addition, Figure 26 illustrates the overlapping and complicated sub-categories of energy with respect to the three dimensions of energy sources, energy processing, and policy issues.

Collectively, the triad I have outlined can be dismantled provided our nation begins to enact public policies that structurally transform the way our society uses energy: namely, increasing energy efficiency use while developing substitution resources.

As noted in Section II--Alternatives, the goal of decreasing foreign energy supplies and the introduction of substitution resources is identical to the Reagan Administration's policies. However, the means, specifically which technologies will be supported for the present and promoted for the future, differ greatly.

The source of this difference is likely the product of how an Administration "views" energy.

The Reagan Administration views energy as a commodity: the supply, demand, and price of energy resources coalesce in the marketplace to present energy choices to producers and consumers, thereby allocating energy effectively and efficiently. Consequently, our nation's industrial growth and standard of living will be assured because the "marketplace" will determine which resources will provide the best "cheap and abundant" supplies to fuel our economy and way of life. As a result, the United States has evolved into a society where citizens' expectations are marketed and satisfied within the context of an energy-intensive economy. This direction may be appropriate except that we are using economic inputs that are finite, ecologically adverse, and internationally unpredictable.

Figure 26. The Three Dimensions of the Energy Issue
Source: *World Energy Atlas*.

Until we create energy policies that appropriately respond to our sheer weight of global and domestic energy consumption, the luxury of categorizing energy as a commodity is over. Instead, energy use and development must be regarded as a public resource, requiring "public policy" committed to solving the issues that have displaced energy resources' position as a commodity. Programs that decrease our strategic vulnerability and ecological destruction satisfy key prerequisites in the process of returning energy procurement to a commodity issue.

The analysis of the Reagan Administration's three energy goals of energy stability, security, and strength sought to highlight those resources and technologies that are receiving preferential treatment as a consequence of conforming to the interests of the principal suppliers of conventional energy--a policy justified when energy is viewed as a commodity.

Under the commodity approach to energy development and use, several concerns were raised including:

- The direction of the society surrendered to private sector decision makers comparatively exempt from electoral accountability presents dangers to our democratic foundations and our ability to avoid war over the preservation of overseas energy suppliers.
- The Administration should recognize "quality of life" as a key component in the equation of standard of living. Its success is realized by reducing consumer dependency levels on fossil fuels, nuclear, or other forms of energy applications that present adverse and potentially expensive or irreversible damage to the air, water, and land defining our national and global existence.
- The fundamental direction and future values of our country involve energy policy, and therefore should receive special policy attention and decisions that are reviewed and endorsed by the nation as a whole, not a comparatively small group of energy industrialists who are motivated by profit and the retention of their comparative monopoly on

the energy resources and services available to American business and consumers at large.

Future United States energy policy making should be designed to secure a "sustainable" end goal of national energy stability, security, and strength, independent of finite resources that may produce unpredictable international trading partners, volatile political relations, and ecological global damage. To achieve this, our view of energy must change and the role of the federal government to implement these new energy policies will need to be expanded.

I have proposed an Ecological/Strategic resource view of energy so that our nation's energy programs are promoted or curtailed with respect to their environmental impact (not just price competitiveness), their sustainability, geopolitical location, and their ability to stabilize and secure long-term national and economic security. Table 20 summarizes the results of conventional and alternative fuel sources when viewed from an Ecological/Strategic criterion.

Table 20. The Ecological/Strategic Energy Agenda

Energy Resource	Environmental Impact	Sustainability	Geopolitical Location	National/Economic Security	Conclusion
Oil	World wide producer of carbon dioxide, global greenhouse effect	None, diminishing supplies	Domestic and overseas, primarily in the Middle East	Threatens both areas	Not member of Energy/Resource Group
Natural Gas	Clean fuel	None, non-renewable resource	Domestic and overseas, concentrations in the USSR and Middle East	Moderate	A limited member of Energy/Resource Group
Coal	Carbon dioxide, acid rain, strip mining	None, non-renewable resource	Large domestic supplies	Low	Not member of Energy/Resource Group
Nuclear	Radioactive contamination	High	Sufficient domestic supplies	Low	A limited member of Energy/Resource Group
Solar	None	Highest	Worldwide	None	Primary member of Energy/Resource Group
Geothermal	Minimal	Highest	Worldwide, concentrations in US, Europe, East Africa, East Russia, Indonesia, Philippines	None	Secondary member of Energy/Resource Group
Wind Power	Minimal	Highest	Worldwide with varying concentrations and seasonal fluctuations	None	Primary member of Energy/Resource Group
Water Power	Hydro-yes; Tidal, Wave, and Sea Thermal-minimal	Highest	Worldwide with various concentrations depending on which technology is being applied	None	Primary member of Energy/Resource Group
Conservation	None	Highest	Worldwide	None	Primary member of Energy/Resource Group

The new facts of energy supply, environmental impact, and strategic considerations, justify the argument to transfer energy development and use to a special public policy category that will not subjugate national energy policy to a relatively small group of private sector energy industrialists who have been trained to produce and maintain profits and any costs, including but not limited to obstructionist efforts to what could be long-term national energy independence programs realized by the expansion of alternative energy technologies. In effect, a pro-business orientation, defined as any commodity or service motivated by supply and demand, cannot be safely applied to energy development and use until the present liabilities of conventional fuels are removed.

The Reagan Administration was successful in convincing the general electorate (or more accurately put, the winner-take-all electoral college system) that his economic agenda would enhance their standard of living. This emphasis on "quantity of existence" lowers the comparative importance on "quality of existence" and suggests that this latter concept represents either a no growth mentality or undue federal intervention in the marketplace on energy acquisition, conversion, and use.

Today, the recently elected George Bush has coined the phrase a "kinder, gentler nation." Yet the commodity view on life in general, and energy policy in particular, is not based on a kinder, gentler nation nor did this sensitivity make the current leading energy industrialists who they are today. Thus far, the Bush Administration has not presented an energy agenda that embraces significant differences from President Reagan's perspective. In fact, although one of President Bush's campaign promises endorsed the Californian opposition on expanded offshore oil sites along the West Coast, this position appears to be wavering and I predict will be reversed at some point during his tenure.

Our nation can begin a slow but steady evolution to reduce fossil fuels and transfer our economy to renewable and conservation technologies. These changes will strengthen our national security, protect our environment, and through resource substitutions, shift our energy-intensive society--based on finite resources--to a foundation of renewable and abundant resources.

Unfortunately, the executive leadership required to move our nation along an Ecological/Strategic energy program has been absent under the Reagan Administration and--given the similar Republican orientation--will likely remain silent under the Bush Administration. Similarly, Congress has not provided the leadership to modify our energy agenda but, in its defense, has acted as a safety net when the Reagan Administration attempted to reduce or eliminate a key counterbalance to the negative environmental by-products produced by our present fossil fuel economy --namely, the Environmental Protection Agency.

The new facts of energy are undeniable. Clearly, our nation should begin a structural change away from nonrenewable and environmentally caustic energy resources toward renewable energy technologies that are both environmentally responsible and not limited to any specific geographic region of the world. The benefits of an Ecological/Strategic energy program should be obvious; yet, until representatives within the Federal government can supersede the vested interests of our present traditional energy industrialists (whose primary mission is profit and preventing other forms of energy that compete with the product they presently control), then our nation will continue to operate in the short-term vacuum that presents national security risks, promotes the greenhouse effect, and dangerously allows a comparative small group of non-elected individuals to impact our standard of living and way of life.

Ultimately, our nation can modify its energy inputs and technically lead the rest of the world to a new economy operating with significantly less nonrenewable resources. However, it is imperative that Congress orchestrate new legislation to make the development and national participation of renewable technologies both economically beneficial for the consumer (and the supplier) and as structurally painless as possible. Alternatively, we can operate in an "act and react" vacuum (simply misconceived as the energy private sector) and thereby subject our nation to undue and preventable environmental and national security risks.

Notes

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World Resources Atlas