

ENERGY SOURCES, UTILIZATION AND ECONOMIC DEVELOPMENT

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Summary

Energy policies offer the means by which nations or groups of nations decide to use energy in order to further their individual or collective goals. The current paradigms for economic development all involve the heavy use of energy to (literally as well as figuratively) fuel economic growth and job growth.

This economic growth results in higher revenues for national governments, who will, in turn, be able to help build a better infrastructure and a better society for their nation's people.

There are many ways to create intelligent and efficient energy policies. The things to consider are: Utilizing existing energy sources in more efficient ways, distributing energy to all people fairly, creating rules which facilitate energy use, problems involved in creating such rules (both within countries and over regions of countries), creating new energy sources and supplies, transitions to utilizing new energy sources, creation and upkeep of infrastructure for an energy source, using energy for economic gain, countries' interests in possessing its own energy, concern for environment in using energy, and the reality of all this.

1. Introduction

Nations, and in an increasingly global environment, groups of nations are and will be finding an urgency in developing policies to address the needs for and effects of energy use. Our survival as a species has been tightly linked to energy consumption. Since the dawn of the Industrial Age, economic growth has been just as tightly linked to energy consumption and to the availability of abundant, cheap energy. This economic growth results in higher revenues for national governments, which are, in turn, be able to help build a better infrastructure and a better society for their nation's people.

The information age may serve to weaken the link for some of the most affluent, technologically advanced nations. Consumer desires nevertheless still commonly equate to substantial energy consumption. In less affluent nations, the connection between energy and development cannot help but remain strong. The development of basic social infrastructure (schools, hospitals, transportation, communications, and even preservation of the forest environments) will require new energy sources. Energy policies will need to seek a balance between consumer demands, resource depletion, development and survival means, and sustainability. The balance itself will be sufficiently difficult to achieve, but the difficulties will only be exacerbated by resource limitations.

All societies are dependent to some extent on energy supply, and the most developed nations are the most dependent on readily available energy supplies. Both heavy and light industry require energy. Energy is necessary to build and to light new homes, to transport goods, to practice modern intensive agriculture, and for virtually every other facet of modern, developed society. As societies develop, their demand for energy grows, necessitating some sort of national energy policy in order to maintain the rate and level of development. Since energy use inevitably results in some degree of environmental effect, a nation's environmental goals are certain to affect its energy and economic policies (and vice versa). Finally, many developing nations are pressured by developed nations to exhibit a high degree of environmental awareness and protection; this, again will have an effect on a nation's economic growth as well as its energy policies.

In general, energy policies can serve one or more of the following purposes:

- Reducing reliance on imported energy
- Environmental protection via reduced emissions
- Environmental protection via reduced mining and drilling
- Environmental protection via reduced spills in transoceanic shipment of fuels (especially petroleum and its refined products)
- Support and/or protection of domestic energy industries
- Protection of domestic jobs that require energy inputs
- Protection of domestic tax revenues
- Encouraging alternative energy uses (e.g. use of renewable energy resources instead of fossil fuels)
- Encouraging preferred practices (e.g. use of mass transportation or ride-sharing)

- Encouraging development of preferred companies or economic sectors
- Personal and/or political gain on the part of powerful national or industrial figures
- Furthering a government's political aims (i.e. buying energy from a less-developed neighboring country to assist their economy, or withholding energy from a perceived competitor)
- Furthering a government's national security interests (i.e. withholding energy from a military rival or stockpiling fuel for a nation's military)

There are many ways to create intelligent and efficient energy policies. The things to consider are: Utilizing existing energy sources in more efficient ways, distributing energy to all people fairly, creating rules which facilitate wise energy use, problems involved in creating such rules (both within countries and throughout regions within and between countries), creating new energy sources and supplies, transitions to utilizing new energy sources, creation and upkeep of infrastructure for an energy source, using energy for economic gain, countries' interests in possessing its own energy, concern for environment in using energy, and the reality of all this (without completely demolishing individual governments and beginning from scratch). The rest of this work will be discussed with these seven points in mind.

2. Utilization of existing energy sources

It is often the case that a particular country lies in a region which has few natural resources. It is then necessary for that country to use what they do have to the best of their ability. For example, Japan has little in the way of energy-producing natural resources. To help reduce Japan's dependence on imported petroleum, the Japanese government began emphasizing the use of nuclear power to the extent that well over half of Japanese electrical energy is supplied by nuclear reactors. As an added bonus, this energy policy (along with the development of cleaner automobiles) has helped to significantly improve the quality of Japanese air. Another resource-poor nation, Lithuania, relies on nuclear power for nearly eighty percent of its energy production as well as selling extra energy as a major source of hard currency.

2.1 Energy Efficiency Improvement

One of the most obvious ways to reduce energy consumption by nations or individual consumers is to implement improvements in energy efficiency. In some nations, this is used as an alternative to constructing new energy production capability and, in fact, there are some instances in which utilities or governments will help to pay the cost of replacing old light bulbs, air conditioners, refrigerators, and so forth with more energy efficient models. The rationale behind this seeming charity is that paying for these replacement costs is often less expensive than building a new power plant, with the added benefit that the replacements are a one-time cost for the utility, which does not then have to maintain a new power plant on a continuing basis. In short, improving energy efficiency helps a nation to do more work with the same amount of energy, freeing up more money to use for other purposes. In addition, this practice makes less use of irreplaceable fuels, results in less environmental degradation, and generates less waste.

There is, however, a limit to what can be accomplished by reducing energy consumption; any society can reduce its energy use only so far before beginning to cut into vital services such as transportation, health care, and basic household needs. There will always be a baseline level of energy consumption needed to maintain a given standard of living, and a society that drops below that level of energy consumption is likely to begin to see a drop in the quality of life its citizens enjoy.

In addition, attempting to implement efficiency improvements may result in only temporary impacts to a nation's energy use practices. For example, in the wake of the Arab oil embargo, consumers in the US became very energy conscious, and many buying habits (particularly automobile purchase) changed dramatically. However, within a generation, the ready availability of cheap petroleum encouraged a resumption of old buying habits, and before the year 2000, many US consumers had again begun purchasing large, fuel-inefficient vehicles. In the case of more energy-efficient light bulbs or appliances, many consumers are unwilling to replace their new, energy efficient equipment with similarly efficient replacements because of the higher cost, so many programs such as those described above result in only temporary reductions in energy usage. In order to give such measures lasting impact, it may be necessary to pass laws or to conduct on-going incentive programs to encourage citizens to continue their "good" behavior over a prolonged period of time. (It is worth noting that policies may encourage a desired behavior either by direct incentives for that behavior or by counter-incentives to discourage the undesired behaviors.)

2.2 Impacts of Fuel Switching

In order to reduce reliance on a particular source of energy, or in order to alleviate the unwanted effects of using an energy source, governments will often encourage citizens to switch from one energy source to another. This may be done in several ways. It may involve giving tax incentives to citizens who undertake this change, or penalizing citizens who choose not to change, as well as giving economic incentives to industry, or passing laws mandating such change. For example, although hydrogen-fueled automobiles are more expensive than their gasoline-powered "cousins", a government may help to subsidize the cost of developing and building such vehicles to reduce the cost to consumers, or a government may give a tax break to consumers who choose to purchase such vehicles. In both cases, the cost to the consumer is reduced, encouraging the purchase of a desirable technology.

However, any program aimed at changing consumers' habits is difficult to implement. Failure to publicize such a program adequately may lead to its failure. Even well-publicized programs may be inadequately funded, or may attempt to change behaviors that are very ingrained. In some cases, consumers are so wedded to a certain fuel that they simply refuse to consider change (such as the change to natural-gas-powered vehicles). The new technology may not be sufficiently mature to accept the influx of new customers, or it may fail to satisfy the new users. These, and many other reasons may lead to the failure of a fuel-switching strategy, and any government that tries to make fuel-switching a part of its national energy policy should be prepared with backup plans. These backup plans may include further (and more drastic) attempts to encourage voluntary fuel-switching, or they may rely on direct governmental action in the form of

new laws and taxes. An interesting example of success lies with the Ghana National Petroleum Corporation's efforts to promote LPG (liquid propane gas) as an alternative to unsustainable dependence on firewood. They employed a sociologist to direct the LPG cookstove project, who coordinated with technical staff in planning it. They embarked on an extensive publicity campaign to persuade people of the advantages of the alternative fuel. (The campaign was undertaken in combination with serious study of the needs and preferences of the people to make the alternative fit the uses dictated by lifestyles and the economy.) It appears to have been a very successful transition, as the program was quickly over-subscribed.

If a fuel-switching plan is successfully implemented, there are still potential impacts on the population and on a nation's standard of living. Most alternate fuels are more expensive than more conventional ones. This means that citizens have less money to spend on life's necessities, as well as less discretionary income to help drive the economy. Even if government-subsidized, fuel-switching plans can have this effect because citizens will either pay higher taxes, the government will have less money to spend on social and infrastructure programs, or governmental borrowing may result in higher interest rates. All of these can have the effect of limiting economic growth. In addition, governments that use tax or subsidy incentives to encourage fuel-switching and other energy policies may face charges of economic protectionism, which can lead to economic disputes with trading partners that can affect a nation's wealth and that of its citizens.

Finally, fuel-switching can have both direct and indirect impacts on a nation's industries. For example, encouraging consumers to change from gasoline to fuel cell technologies may lead to a reduction in petroleum demand. This, in turn, will result in lower output of petroleum products and possible job losses in the petroleum industries and their supporting industries. Regions (such as the US Gulf Coast or the Middle East) that are heavily dependent on the use of petroleum will be more heavily affected by this drop in demand, while areas that manufacture fuel cells, their components, and their support systems will see a surge in business. Other economic effects will propagate through the economy as it adjusts to this major change in energy (and technology) use.

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Biographical Sketches

Ben W. Ebenhack is a Sr. Lecturer in Chemical at the University of Rochester, in Rochester, New York, where he teaches courses on Energy and on the Role of Technology in Development, among others. He is also the founder and president of the AHEAD Energy Corporation, a public charity that seeks to assist Lower Income Countries in identifying and developing their own energy resources for their own use. He formerly held several positions with a multi-national petroleum company. He has particular expertise in Formation Evaluation technologies, including a patent and other discoveries. He holds BS and MS degrees in Petroleum Engineering from Marietta College and the University of Wyoming respectively. He is the author of the textbook, *A Non-technical Guide to Energy Resources: Availability, Use and Impact*, from PennWell publishers, in 1994.

Andrew Karam began his radiation safety career in the Naval Nuclear Power Program, in which he was enlisted from 1981 – 1989. Following completion of his training, Andy served nearly three years as a staff instructor before reporting to the USS Plunger (SSN 595), a fast-attack submarine stationed in San Diego. During the next 3 ½ years, Andy completed 2 extended deployments to the Western Pacific and served as Leading Engineering Laboratory Technician for over two years.

Following his discharge from the Navy, Andy returned to the Ohio State University, where he completed an undergraduate degree in Geology in 1993. It was during this period that he decided to make a career of health physics.

Taking a job at the Ohio Department of Health, Andy worked primarily with DOE sites and other contaminated sites. This work fascinated him, and was one of the factors leading him to become a professional health physicist. This work, too, led him to join an environmental consulting firm, where he was the Manager of Radiological Services.

In 1996, Andy returned to graduate school to complete his MS in Geology. In keeping with his recent past, he worked full-time for the OSU Radiation Safety Office while taking classes and completing his thesis. In 1998, after completing his degree, Andy accepted a position as Radiation Safety Officer at the University of Rochester, where he has worked for nearly three years. He completed his Ph.D. in Environmental Science in 2001, again graduating from the Ohio State University.

Andy is active professionally as a past President of the Western NY Chapter, an associate editor for the HPS Newsletter, and editor of the HPS Medical Section's electronic newsletter. Andy is also a periodic contributor to ORS and the Health Physics Journal, he has contributed pieces for several other magazines and journals in the US, Europe, and Iran, and he has presented a number of lectures, papers, and posters at meetings in the US, Europe, and Asia.

Outside of work, research, and other professional activities, Andy enjoys time with his family; Kathy, Alexander, Ben, and assorted cats. He also enjoys reading, writing, photography, travel, and cooking.