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CENTRAL COAST REGIONAL COMMISSION

CALIFORNIA COASTAL ZONE CONSERVATION COMMISSION

ENERGY

Part of a Study of the California Coastal Zone

Summary of the Report, "Energy", Compiled by  
State Commission Staff

The California Coastal Zone Conservation Act of 1972, (Proposition 20 at the election of November 7, 1972) created the California Coastal Zone Conservation Commission and six Regional Commissions, and directed them to prepare a comprehensive, enforceable plan for the preservation, protection, restoration, and enhancement of the coastal zone.

This is one of a series of informational reports designed to help the Central Coast Regional Commission carry out this responsibility. Using these reports, the Regional Commission will develop recommendations to the California Coastal Zone Conservation Commission on statewide policy to this Region. These recommendations, together with the recommendations of the other five Regional Commissions, will be the basic materials the State Commission will use in planning for the future of the California Coast.

Each report focuses on a specific aspect of the Coastal Zone. The relationship of this report to others in the series may be seen at a glance on the next page.

This summary report was prepared by the Commission staff to focus on the most important Coastal planning considerations suggested by the more extensive technical report. Possible planning recommendations based on this report are listed at the end. These are only tentative, since the conclusions based on this report will need to be considered later, after other reports on different aspects of the Coastal Zone have been completed.

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SANTA CRUZ

OCTOBER 1, 1974

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This summary is abstracted from an extensive technical report covering statewide and regional issues. Copies of the technical report are available for review at the Commission office or at the following public and school libraries:

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- Tankers plying coastal waters and harbors—
- Offshore platforms and islands pumping oil—
- Power plants looming large on rural and urban waterfronts—
- Refineries working around the clock, surrounded by industrial plants—
- Automobiles, factories, homes...using oil, gas, electricity—

\* \* \* \* \*

Consumption of energy is part of every facet of modern living. Energy aids in the growing of food, and the delivery of water from distant locations; it warms and cools buildings, runs industrial plants, provides fuel for transportation, and allows Californians to enjoy all the amenities they have come to expect. At the same time, the production and use of energy often upsets our environment by causing air and water pollution, disfiguring landscapes, and pre-empting other valuable land uses. This report is concerned with the effects of energy production and use upon the California coast.

Massive energy production facilities impact upon the coast in many ways, not only by the visual impact of power plants and oil drilling equipment but also by oil spills, air pollution from refineries, disposal of cooling waters, and the pre-emption of coastal land that might be used for other development, agriculture, or recreation, among other possible uses. Yet to come are new power plants, tanker terminals, liquefied natural gas facilities, and oil drilling installations throughout the California coastal zone.

Much of the State's oil and gas production comes from the coastal zone, and there are increasing demands to drill offshore in State and

Federal waters. Most of California's electrical generating facilities, both fossil fuel powered and nuclear power plants, are located in the coastal zone. Tankers tie up at ports along the coast; onshore and offshore terminals for mammoth tankers are being advocated. And because most Californians live in, or frequently visit, areas of the coast, most of the State's energy consumption occurs in this strip of land and ocean running the full length of the State.

Future plans for the conservation and development of the coastal zone, therefore, will dramatically affect the energy demand and supply for the entire State, and to some extent, other parts of the nation.

This report attempts to trace the main threads of the complex energy situation and to develop strategies for minimizing adverse effects upon the coastal zone and society. It was prepared from a myriad of sources, including national and State government studies, private industry projections and statistics, technical publications, and public testimony of many energy experts and concerned groups. The evolution of this report has been influenced by information and comments offered by representatives of State and Federal agencies, oil companies, utility companies, environmental groups, technical experts, interest groups, and university professors.

#### California Within the Larger Energy Picture

Once the United States was self-sufficient in its use of energy. In fact, until 1950 the U.S. was a net exporter of energy (primarily oil and gas). The rapidly increasing use of energy in all facets of life and the downturn in growth of domestic energy production have reversed the national trend, however, to a point where the U.S. now imports approximately 15 percent of its energy, and 35 percent of its



oil. This trend of dependency of foreign sources shows few signs of slackening, and will undoubtedly have large repercussions on California's and the nation's supply and sources of energy. For example, the price of Arabian crude oil affects the price of gasoline in Los Angeles and the entire State, and the availability of imported Canadian natural gas influences gas and electricity prices in nearly all communities. The energy demands placed on California, and on its coastal zone, are greatly affected by foreign, U.S., and out-of-State energy trends.

#### United States in the World Energy Situation

The United States and the world are increasing their consumption of energy faster than supply can be increased. As the large industrialized powers in the world have become more and more dependent on foreign energy sources (primarily oil), the interrelationships among world energy supply sources have increased. Power plants in California, Japan, France, and other nations depend on foreign low-sulfur fuel oil and natural gas. Individual refineries, tankers, and pipelines service the needs of many nations, the United States included. All of these complex factors blend into a world energy situation of great interdependence among nations.

The United States once consumed an incredible 47 percent of the world's total energy; that figure has fallen over the past 50 years to 33 percent, still a disproportionate share for a country with only 6 percent of the world's population.

Despite its domination of world consumption, the United States finds itself increasingly vulnerable to the economic and political decisions of the Organization of Petroleum Exporting Countries (OPEC), which controls approximately 85 percent of the world's oil reserves

outside of the Soviet Union, Eastern Europe, and the People's Republic of China. The "Arab oil boycott" affected all aspects of American energy consumption and prompted President Nixon's call for "Project Independence" for supplying the nation's energy.

Many authorities doubt the desirability or practicality of attempting a total American self-sufficiency in energy because of the many significant environmental impacts that would occur. Even those authorities, however, recognize that the production rates, prices, and availability of foreign energy are governed by the policies of the overseas nations, who can quickly cut off or reduce the exports to the U.S. for economic or political reasons. In any case, the U.S. will undoubtedly continue to be dependent on foreign energy sources in some significant degree for decades.

Besides seeking new supplies, the U.S. is beginning to examine ways to reduce its rate of consuming the scarce energy resources of the world. Developing nations of the world, representing the bulk of the world's population, presumably should eventually enjoy something approaching the developed nations' standard of living. The magnitude of the potential world energy demand compared to known energy resources, and the cumulative environmental impact of greatly increased energy production should be reason enough for the United States and other developed nations to slow their energy consumption growth rates. Such a slowdown will require greater energy efficiency, better technology, and changed attitudes concerning wasteful energy consumption within all facets of U.S. life.

#### National Energy Situation

Use of energy in the United States has been outgrowing our ability to provide it. United States energy consumption increased at an average

yearly rate of 3.5 percent between 1950 and 1965, and has jumped to an alarming 5.0 percent annually since 1965. By contrast, the population growth rate is slowing down to almost zero.

The dramatic increases in energy consumption resulted from many factors. Artificially low crude oil and natural gas prices, kept low by inexpensive foreign petroleum and manipulation of foreign oil import quotas, by the Federal Power Commission's lid on the price of natural gas (at the wellhead) for interstate use, and by Federal control on fuel price increases since 1971, encouraged all sectors of the United States to use more fuel. Energy was a bargain in the 1960s compared to other necessary purchases; in fact, the overall price of energy declined relative to the prices of other goods and services. Natural gas and electricity rate structures for pricing encouraged energy consumption by charging lower unit prices per British Thermal Unit (BTU) for larger users than for smaller users. Tax incentives on large capital investments promoted the construction and use of energy-intensive equipment for industry. Rapid expansion of the highway and road systems, in conjunction with sprawling suburbs, caused a tremendous increase in the daily use and casual consumption of gasoline. Domestic tax credits for American oil companies operating overseas, and monetary incentives frequently offered by other countries prompted the cheap production and refining of petroleum abroad. All these complex factors, and more, combined to offer America an artificially low price on energy, and encouraged its increasing use.

While the country used energy at a soaring rate, domestic production increased only 3 percent annually between 1950 and 1970, and has since fallen to virtually no yearly increase at all. In the case of oil

this was caused by discouraging economic prospects for domestic production relative to cheaper foreign operations. In the case of natural gas the artificially low wellhead prices imposed by the Federal Power Commission (FPC) discouraged domestic natural gas exploration and recovery. Therefore, the increased domestic consumption of energy has been supplied from overseas sources, principally foreign oil and Canadian gas. In 1973 the United States used 75,600 trillion BTUs of energy, but only 62,000 trillion BTUs were produced domestically.

Not only has the use of energy significantly increased, but also the make-up of the U.S. "energy supply mix" has dramatically changed. In 1950, the last year of domestic energy self-sufficiency, the country's energy mix was 39 percent petroleum, 38 percent coal, 18 percent natural gas, and 5 percent hydropower. As of 1973 our annual energy consumption had increased  $2\frac{1}{2}$  times since 1950, and the national energy mix had become 46 percent petroleum, 31 percent natural gas, a greatly reduced 18 percent coal, 4 percent hydropower, and 1 percent nuclear.

These major energy switches resulted from many factors. Consumption of oil and gas increased primarily because of low prices, great flexibility of use for many fuel purposes, ease of transport through pipelines and tankers, and relatively clean-burning characteristics compared to coal. Coal's percentage of the U.S. energy mix fell drastically because of its higher per unit costs, stricter safety regulations for shaft mines, environmental regulations on types of mining, and the greater "dirtiness" from its burning. Hydroelectric energy generally maintained its overall percentage of the energy mix, although there were relatively few additional hydroelectric sites developed between 1950 and 1970. Finally, nuclear power emerged as a potential

major source of electricity generation. All of these factors and more combined to create energy switches toward use of petroleum and natural gas, and away from consumption of coal.

All four major sectors of the economy—industrial, transportation, residential, and commercial—experienced large increases in energy consumption. Industry uses approximately 40 percent of the nation's total energy package, and is also the least efficient in its use of energy. The U.S. is a mobile society, so transportation consumes about 25 percent of the nation's energy. The 4.3 average annual growth rate of energy consumption in transportation since 1960 reflects not only the increased use of transportation, but also the move toward less efficient modes of transportation (e.g. car and planes instead of buses and trains). Residential use of energy increased 50 percent during the 1960s, and now accounts for approximately 20 percent of the nation's energy consumption. Finally, the commercial sector of the economy uses only about 15 percent of the nation's energy, but has grown at the high annual rate of 5.4 percent since 1960.

Cutting across all four sectors of the economy was the increased use of electricity. Electricity must be distinguished from other sources of energy because it is an intermediate energy source produced from the basic fuels such as oil or coal. Consumption of electricity grew at an annual rate of 7.4 percent and more than doubled in the 1960s, and electricity production now consumes over 25 percent of all primary fuels used (oil, natural gas, coal, and uranium). Electricity is a highly flexible form of energy and can be used in all sectors of the economy. However, although all energy consumption is somewhat inefficient (i.e. effectively uses only a portion of the possible energy potential of a fuel), electricity is produced by consuming another fuel and is therefore

even less efficient for uses where it replaces direct fuel use (e.g., use of electricity in the home for heating is only one-half as efficient as use of natural gas for that purpose). Electricity generation using steam wastes approximately 65 percent of the primary fuel used.

#### Future Energy Sources for the Nation

As uncomfortable as the U.S. reliance on foreign oil sources is, many authorities doubt our ability to ever again reach a self-sufficiency in oil and natural gas. Most of the easy-to-find, easy-to-extract oil and gas have already been produced, and new efforts to find domestic petroleum involve drilling in very deep, very expensive wells, and looking to offshore drilling on the continental shelf lands.

The sophisticated technology and large investments needed for offshore production are now becoming available with higher oil prices. Offshore production already accounts for approximately 20 percent of our domestic production, and that figure may go up sharply in the future. The slowdown in offshore drilling following the 1969 Santa Barbara oil spill is now being reversed, as more companies accept the increased economic risks, the increased costs in meeting environmental regulations, and the possible penalties for an oil spill in exchange for the chance at drilling for large new offshore reservoirs.

President Nixon has called for 10 million acres of outer continental shelf lands to be leased every year for the next five years, and oil companies hope to eventually produce in offshore California waters, in the Gulf of Mexico, along the Atlantic coast, and in the North Slope and Cook Inlet areas of Alaska. Any major offshore production, if approved, will not significantly affect U.S. domestic oil and gas supplies until the late 1970s and early 1980s. Construction of the Alaskan pipeline has also now begun and is expected to come on line by 1978.

If the U.S. should be fortunate enough to increase its oil and gas production, refinery capacity must be rapidly expanded. Termination in late 1973 of the Oil Import Program (in existence since 1959) and increased prices for petroleum products stimulated proposals for refinery expansion in this country, but it is unclear if the increased capacity will satisfy the total refinery need. Desulfurization refining capacity (removing sulfur from some crude oil) must also be expanded in order to provide oil to meet the air pollution standards for power plants. In the last five years, U.S. refinery capacity has steadily fallen behind refined product needs.

The domestic natural gas supply situation is even more critical than that for oil. The Federal Power Commission (FPC) recently raised natural gas prices, which should result in slowly increasing domestic production. However, in the near term, shortages will be common.

Major interstate distributors have curtailed deliveries, and recent regulations of the FPC have effectively forced large gas customers, such as public utilities and heavy industry, to switch almost entirely to scarce fuel oil. As a result, increasingly large quantities of low-sulfur fuel oil must be imported in order to satisfy their fuel needs while meeting air quality standards. Meanwhile the search for new sources of supply has resulted in projects to produce gas from coal and solid wastes and to import it as liquefied natural gas from countries around the world. For example, there are two competing proposals for bringing gas from the Alaskan North Slope and Mackenzie Delta to the U.S.: a large network of gas pipelines from Alaska through Alberta, Canada, and then to the Midwest and Pacific Northwest; or a natural gas pipeline parallel to the oil pipeline from the North Slope south to

Valdez, where it would be liquefied and shipped in large liquefied natural gas (LNG) carriers south to California.

Coal, the use of which has declined 55 percent since petroleum took over as the nation's largest source of energy in 1950, comprises 80 percent of our remaining domestic energy reserves. Several major developments are well underway that will result in increased use of coal. Low-sulfur coal is being mined in large quantity in the western states and being shipped by train to the Midwest and East Coast for electric utility use. And devices for cleaning up the exhaust gases from burning coal may eventually permit its increased use. New technologies for producing sulfur-free synthetic petroleum from coal will be in commercial use within the next five to ten years.

Over the past 20 years, nuclear power has received by far the most attention from the Federal government as the most significant long-term future source of energy. Although nuclear electrical generating plants produced only 1 percent of the nation's energy in 1973, the Atomic Energy Commission presently projects that nuclear energy will supply about one-half of all electricity consumption in the year 2000. Nuclear technology produces no air pollution, relatively little noise pollution, and does not consume scarce supplies of gas and oil. Despite the optimistic projection of nuclear energy supply, however, a number of significant environmental and public health problems attend nuclear power plant development, including nuclear reactor safety, waste heat disposal, radioactive wastes management, and theft of nuclear fuels, all of which have provoked a new debate over the merits of nuclear fission energy.

The relative scarcity of oil and gas, the environmental and economic problems inherent in extracting, transporting, refining, and burning fossil fuels, and the problems surrounding nuclear power have



recently provoked a hard look at alternative energy sources for a new national energy mix. These sources include traditional hydropower, improved nuclear technologies (which may eventually include nuclear fusion), geothermal, solar, solid wastes, wind, and tidal.

Because of the uncertainties surrounding the development of new energy technologies, most projections of future energy supply rely heavily on mere extension of the trends of the past, and too often ignore or minimize the possible future contributions of alternative sources of energy. These projections in turn inevitably discourage attempts to research and develop energy alternatives, while promoting further development of those sources already forecast.

The energy scare brought on by the late 1973-1974 shortage of oil and natural gas helped to challenge the conventional projections of supply mix, however, and has generated a new interest in development of alternative energy sources. For example, the Federal government budgets for development of new sources have increased, though they are still a small fraction of the commitment to nuclear fission. Proposed Federal legislation would establish a new agency called the Energy Research and Development Administration, primarily to support the new development of energy sources and improve energy efficiency.

The U.S. energy situation is changing constantly, defying both accurate forecasting and absolute control through rigid energy policies. There are many choices—some still not even identified—to be made in the coming years that will affect the entire nation's energy mix. Decisions made at the national level that will affect the future energy mix—decisions as to how much research money should be given to solar energy, for example, or how many leases should be granted for oil

drilling in Federal waters, or allocating oil and refined products—will substantially determine the long-range energy options of the individual states.

However, many of the crucial decisions regarding energy supply will be made by the states themselves; this is particularly true for a large and complex state like California. Although California's future energy supply mix and the implications of that supply mix for the coastal zone will evolve within the framework of national energy policies, many of the specific decisions regarding energy source priorities, the location of energy facilities, and environmental regulations will be made by the State itself, on the basis of its own economic goals, its own environmental policies, and its own energy needs.

#### California's Energy Situation

California is already confronting many difficult energy problems; but problems requiring still tougher decisions—decisions that will particularly affect the coastal zone—will increase during the coming years. The State Lands Commission has lifted the drilling moratorium on offshore petroleum operations from existing platforms. Such drilling is now to be approved on a lease-by-lease basis. This will lead quickly to thorny questions of if, when, and how new offshore platforms and drilling should be permitted. Electric utility companies will continue to propose expanded or new fossil fuel and nuclear power plants on sites within the coastal zone. Oil company efforts are presently underway for new or expanded refineries, tanker terminals, and liquefied natural gas (LNG) facilities along the coast. In addition, there are many promising research projects into the potential of such energy sources as geothermal, hydroelectric, solar, and wind, all of which could capitalize on California's own diverse natural resources.

Decisions on such complex energy issues should ideally be made primarily by a single State energy agency responsible for planning for overall energy development and conservation for California. The recently established Energy Resources Conservation and Development Commission, to begin operation in January 1975, is a significant step in that direction though it still lacks authority over supply issues relating to oil and natural gas. In passing the legislation enacting the Energy Resources Conservation and Development Commission, the California Legislature declared that "the present rapid rate of growth in demand for electric energy is in part due to wasteful, uneconomic, inefficient, and unnecessary uses of power and a continuation of this trend will result in serious depletion or irreversible commitment of energy, land and water resources, and potential threats to the State's environmental quality."

The Commission is responsible for future siting of power plants, for instituting comprehensive energy conservation policies and programs (e.g. labeling electrical appliances with their energy efficiencies), for forecasting and assessing energy demands and supplies, and for instituting an accelerated program of research and development for energy forms and technologies. The Commission will have no siting or regulatory authority in petroleum matters, however, which leaves these matters in the hands of a confusing and sometimes conflicting array of agencies. Offshore drilling proposals, tanker terminals, LNG facilities, and refineries all warrant an integrated approach to determining the relative needs for the facilities and their optimal locations. In all cases, the constant objective of energy development should be the wise and efficient exploitation and use of resources while ensuring maximum protection of the environment.

When a proposal is made for offshore oil exploration and production, for a power plant on the coastline, or for new or expanded refineries or tanker terminals, for example, the need for the additional energy should first be determined. Only after analysis of California demand and supply has shown that there is such a need should the question of finding an environmentally acceptable site be addressed. Thus an understanding of California's energy demand and supply is essential for planning for the coastal zone.

#### 1. California's Energy Demand

The growth in California's demand for energy has roughly paralleled the national trend. The State experienced a 5 percent annual increase in the use of energy between 1968 and 1973, which if continued would result in a doubling of consumption every 15 years. During the same time period, the in-State production of energy dropped. This created a need for more and more imports, and precipitated new energy supply problems.

In several ways, California's energy demand is different from the nation's. California consumes more energy for transportation and less for industry than the nation as a whole; California lacks in-State coal resources and, in any event, air quality regulations prevent the direct use of coal for industrial and power plant boilers. As a result, approximately 90 percent of the State's energy demand was satisfied by oil and natural gas—well over the 75 percent accounted for by oil and natural gas in the nation.

Recent statistics on energy use are surfacing that indicate that fuel scarcity and increased prices have slightly depressed demand in California. Gasoline and electricity consumption have been generally

down from the corresponding months of last year. Several studies now indicate that energy demand is somewhat flexible and depends on prices, i.e. that there is some "price elasticity" to energy demand. Energy shortages combined with increasing prices can be expected, therefore, to partially discourage consumption.

Energy demand studies completed in 1973 by the Resources Agency of California and the Stanford Research Institute (SRI) resulted in high forecasts of future demand. Both forecasts, however, were based primarily on assumed continuation of past and present energy use, and were completed before the late 1973-1974 energy crunch and the conservation awareness it generated. They do not acknowledge the potential for significant demand reductions as a result of energy conservation practices and increased prices, and they minimize the role of alternative sources in California's future energy mix.

The most realistic energy projections to appear to date are those included in the recent Rand Corporation study. The Rand projections take into account the impact of energy price increases and resulting reduction in demand. The Rand Case 2 scenario results in a 30 percent lower demand for electricity in the year 2000 than does the projection of the California Public Utilities Commission.

Other developments that can further reduce California's future energy demand are conservation programs, more efficient use of energy, increased use of mass transit, more compact communities, and large-scale recycling. Energy consumption can be further reduced, and supplies somewhat expanded, by de-regulating the price of crude oil, by allowing the price of natural gas to rise, and by restructuring the electricity rate structure to show consideration of the concepts of marginal cost

and peak load pricing. These pricing changes would increase the incentive for new production while depressing demand, because of the higher prices to energy users. To reduce demand for energy-producing facilities in the coastal zone and the entire State, the Energy Resources Conservation and Development Commission should institute widespread energy conservation programs and public information campaigns on the controversial subject of energy.

## 2. California's Present Energy Supply

The growth in supply of energy from in-State sources has deteriorated from the time when California was a net exporter of energy to the point where in November 1973, California was importing 57 percent of its total energy. The imported sources were foreign crude oil and refined products, and crude oil from Alaska and the Rocky Mountain states (40 percent of daily demand); natural gas from the southwestern United States and Canada (75 percent of daily demand); electricity from the Pacific Northwest and the Southwest; and nuclear fuel from the Rocky Mountain states. These energy sources arrived in California by pipelines, tankers, trucks, and electricity transmission lines. Transportation or transmission, processing, and actual consumption of all of these out-of-State sources affects the coastal zone. This large dependence on outside energy sources gives no immediate signs of changing.

Petroleum represents 90 percent of the State's energy supply. Hydroelectric power has slightly decreased its supply of the State's energy to approximately 9 percent of the total. Geothermal energy and coal have both slightly increased their roles in the State's energy picture, each to roughly 1 percent. A fortunate winter of heavy

precipitation in 1973-74 will provide unusually large water supplies for California's hydroelectric facilities. California's nuclear capacity is also expanding slowly and additions to the San Onofre power plant will expand the State's generating capacity in a few years, if the new generating units come on line. Electricity generated from primary energy sources now accounts for 25 percent of the State's total energy consumption.

Even with higher consumer energy prices, successful conservation practices, improved technology allowing increased energy efficiencies, and changes in energy-use patterns and life-styles, the State's consumption of energy will increase to some degree.

### 3. Resources for California's Future Energy

Most projections of national and State energy supplies estimate that crude oil will be the largest single source of energy, at least through 1985. California has produced a total of 16.3 billion barrels to date, but the entire State still has estimated future recoverable oil resources of 59.4 billion barrels. Over 32 billion barrels of this oil remains in onshore reservoirs, 20 billion barrels in Federal outer continental shelf lands, and 6.4 billion barrels in offshore State reservoirs. Although these numbers are large, any increase in California's oil production will result only from large investments for stimulating production from existing wells, from drilling for new oil, and from improved technology that will increase the overall recovery of oil from reservoirs. Drilling for new oil, and oil field production in general, have been declining for five years, partially because of the drilling moratorium on State offshore lands. However, the increased prices of oil, in addition to renewed efforts at offshore drilling and

a new emphasis on greater national "energy self-sufficiency", will probably result in expansion of in-State oil production. Increased production will only be achieved over many years of development, and at greater costs to the oil companies that will surely be passed on to the consumers in the form of even higher prices.

The California State Lands Commission has lifted its five-year moratorium on offshore drilling, and is now approving drilling from existing platforms on a lease-by-lease basis. In addition, the U.S. Department of the Interior has called for lease proposals for drilling in 1.6 million acres of offshore continental shelf lands stretching from Ventura County to San Clemente Island. Drilling on these Federal lands could threaten to deplete reservoirs extending into adjacent State petroleum resource sanctuaries (large areas near the shore where State law forbids oil drilling for environmental and resource conservation reasons). This would force California to produce oil from the sanctuaries in order to protect its share of the reservoirs and the substantial revenues from them.

Oil is recovered from wells with varying degrees of efficiency (never is 100 percent of a reservoir fully recoverable). Oil companies and the Division of Oil and Gas insist that California's regulations for oil production are equal to or more strict than those of other states, but a comparison of relevant state statutes reveals a wide disparity in the regulation of petroleum operations, with California's apparently more lax. Improved regulatory laws would most likely increase the volume of petroleum recovered. For instance, legislation should be enacted, similar to existing laws in Texas and Louisiana, authorizing the Division of Oil and Gas to regulate the production practices of



individual wells. Recovery efficiency and identification of additional reservoir capacity could be further aided by the California Legislature passing a law requiring the Division of Oil and Gas to gather all exploratory and production data from oil companies, which could then add to the public pool of knowledge about the extent of reservoirs, and lead to greater understanding of the State's petroleum resources.

Oil needs not met by California's production will be satisfied by imports. Large portions of the Alaskan pipeline flow from the North Slope may come to California by tanker as early as 1978 for refining and consumption. This large volume of oil will drastically reduce the need for California to import petroleum from foreign nations. Should the Alaskan oil be augmented by increased California production or modest imports from overseas, the State may have a surplus of oil as early as 1979.

Even if California can supply all its needs of crude oil, it must be refined in order to be usable. Refinery capacity increased at a rate equal with product needs during the 1960s, but additions have fallen off considerably since then. During the period from 1971 to 1973, refinery capacity increased only 40,000 barrels per day—well below the needed expansion. As a consequence, California has been forced to import more refined products since 1971, primarily residual fuel oil for utilities, and has also reduced the State's export of refined products.

At present the oil companies have announced plans to expand California's present refinery capacity of 1.8 million barrels per day by an additional 700,000 barrels per day by the end of 1977. At this rate, the refinery needs projected for 1985 (which are probably high because

they fail to take into account reduced product demand caused by higher prices, energy conservation practices, and development of alternative energy sources) will be satisfied by the end of 1977. This is being accomplished by 12 individual projects either expanding existing facilities or constructing plants at new sites. Of the 12, only three expansion projects are within the coastal zone, and the largest of them—a 175,000-barrels-per-day expansion of the El Segundo refinery—has already been approved by the Coastal Commission.

California presently lacks any desulfurization capacity in its refineries. Air pollution standards permit only low-sulfur crude oil or desulfurized fuel oil to be burned in power plants. Therefore, the State relies on a steady stream of tankers to provide foreign low-sulfur crude and fuel oil. The El Segundo refinery expansion will include the first desulfurization capacity for the State. Future refinery capacity increases should maximize use of desulfurization technology in order to reduce the need for foreign imports.

California's petroleum demand will continue to require oil arriving in tankers, from Alaska and overseas, though the volume of imports will undoubtedly fluctuate. No tanker larger than 138,000 deadweight tons (dwt) can be accommodated in existing California tanker terminals, although this size limit can be increased to 150,000 dwt with minor in-harbor dredging. There are several proposals to construct new or expanded tanker facilities in California: Estero Bay, 400,000 dwt limit; Los Angeles, 200,000 dwt limit; and Moss Landing, 130,000 dwt limit. These facilities have been proposed primarily to reduce transportation costs of importing foreign petroleum by allowing shippers to use very large crude carriers (tankers of 200,000-400,000 dwt).

However, existing facilities can already accommodate projected 1985 import needs. Even the 1985 projections are probably high as a result of anticipated demand growth reduction and expected near-term increased in domestic production from Alaska and California. Therefore, no new or substantially expanded tanker terminals are required until at least 1985. Existing facilities can and should be utilized more efficiently, with two or more companies sharing presently one-company terminals.

In order to prevent the unnecessary and environmentally hazardous use of very large crude carriers to ship crude oil to California for transshipment outside of the western states, future tanker volumes should be restricted to the size necessary to meet the requirements of the Fifth Petroleum Administration for Defense (PAD V—California, Arizona, Nevada, Oregon, Washington, Alaska, and Hawaii). This may require oil companies to exchange crude oil volumes instead of using California as a shipping center (e.g. exchange Alaskan oil to be marketed in the Midwest for Middle Eastern oil bound for California).

Generally, California will continue to rely heavily on oil for at least a decade. All aspects of the State's demand and supply of petroleum—availability of crude oil and natural gas, refined products, allocations, and pricing—will continue to be affected by the Federal Energy Agency. The California Energy Resources Conservation and Development Commission will also affect the dynamics of California's petroleum demand and supply as its use fits into the State's entire energy picture.

California only produces 25 percent of its natural gas consumption at present. Though there could be increased natural gas production

associated with offshore oil production, California's natural gas will continue to come primarily from out of State: from the southwestern states, western Canada, and imports from other countries. There are also serious proposals for constructing facilities within the coastal zone to receive, store, and vaporize liquefied natural gas (LNG) transported in specially designed ships from Alaska and abroad. California presently has one LNG storage facility in San Diego, but there will be substantial new developments to accommodate arriving LNG. Present proposals include siting these facilities at Los Angeles/Long Beach Harbor, Port Hueneme, and Point Conception.

Most public utilities and government agencies concerned with energy generally agree that the electrical generating capacity at the turn of the century will be over one-half nuclear, one-quarter fossil fuel (principally oil, natural gas, and coal), one-tenth hydroelectric, and perhaps one-tenth geothermal. Such an energy mix would require large increases for the next 25 years in nuclear power plant capacity, a relatively smaller increase in the use of fossil fuels and hydroelectric power, and increased geothermal capacity. These generally accepted projections, however, apparently minimize the potential contributions of alternative energy sources because of the inability to plan firmly on their contribution.

However, if there were a strong policy commitment by government bodies and electric utilities to high levels of research and development of alternative energy technologies, and to extensive marketing and public education, then new energy technologies could make a greater contribution to future electrical energy supply than is presently projected. For example, California enjoys the best prospects of any state for geothermal energy, possesses a considerable number of sites for

pumped hydroelectric (pumping water back up into reservoirs during periods of low demand to be available at peak demand times), and has a troublesome quantity of solid wastes which could contribute to electrical energy production. In addition, solar and wind energy could contribute significantly by the turn of the century. It is estimated that up to one half of electrical generation capacity added between now and the year 2000 could be provided by alternative sources of energy.

If alternative sources were more fully exploited, dependence upon conventional electricity sources could be greatly reduced. Oil companies, electrical utilities, the Public Utilities Commission staff, and other groups question the impact of future alternative energy forms and doubt the wisdom of assuming that these energy sources will become abundantly available. The promise of alternative energy sources, however, is only as strong as the institutional and financial commitment to developing them. The new State Energy Commission will staff and fund programs to research the prospects and recommend development of at least the following alternative energy sources: geothermal, solid wastes, solar, and wind. Projects should begin immediately to promote the use of solid wastes for electricity generation, an innovation already successfully employed elsewhere in the U.S.

The need for every new facility proposed for the coastal zone should be examined by the Coastal Commission in cooperation with the Energy Commission even before the environmental effects on the coastal zone are considered. Every proposal for a major energy facility in the coastal zone (e.g. power plants, offshore petroleum leases, tanker terminals, LNG facilities, refineries) should be balanced against alternative means of providing the amount of energy to be provided by the proposed facility.

## The Environmental Effects of California's Future Energy Sources

Once a need has been established for greater supplies of energy, energy development projects must be located, designed, and operated in such a way that their environmental effects are minimized. Each energy source suffers from particular environmental or safety problems, and must be weighed against other energy sources to determine its relative desirability.

### 1. Petroleum Exploration and Production

Oil fields, which produce crude oil and natural gas, represent a long-term commitment of land and resources that may be partially "irreversible or irretrievable" as defined by the California Coastal Zone Conservation Act. Many thousands of acres in the State are presently utilized for petroleum operations, usually to the exclusion of any other land uses until after the oil field is abandoned. Some old oil fields are converted to other uses. Drilling and production procedures, whether onshore or offshore, involve risks of oil pollution. However, because of the less familiar and more unpredictable nature of the ocean environment, offshore petroleum activities tend to be more hazardous than on land. Considering the total number of wells drilled in California, there have been remarkably few oil blowouts or spills, but the Santa Barbara Channel oil spill of 1969 brought into focus the environmental impacts of offshore drilling.

Present containment and recovery equipment for oil spills is reasonably effective in calm sea and weather conditions (i.e. wave heights below five feet, currents less than one knot), but moderate to heavy conditions will spread an oil spill despite rigorous application of man's best available technology. If not contained, spills can spread relatively fast, depending on conditions.

There are conflicting reports on the ecological effects of oil spills. Refined products definitely have more severe effects on marine life than crude oil. The effects tend to be more profound as the spill enters areas close to shore, and they are particularly damaging in such sensitive areas as estuaries and marshlands. Although some animal and plant species are particularly vulnerable to oil spills (e.g. many birds, mussels and barnacles, marsh grasses), most populations seem to rebound within months or years after a crude oil spill. There have not been sufficient studies of the sub-lethal and long-term effects of oil spills, particularly as they affect entire ecosystems. Hydrocarbons are basically poisonous to most forms of life, although toxicity levels are not always reached.

It is clear that there are large economic losses from oil spills, including damages to personal property associated with commercial fishing, recreational sites, tourist activities, and ocean-related activities generally, in addition to the unwelcome visual impact of oil on the ocean, on coastal rocks, and on sandy beaches.

Since the 1969 spill in the Santa Barbara Channel, the technology for preventing, containing, and recovering oil spills has improved, but the fact remains that onshore petroleum activities are generally less hazardous than offshore operations.

If new drilling proposals are approved, both State and Federal offshore production will use fixed platforms with many wells per platform, underwater pipelines to onshore treating and storage facilities, and significant onshore developments. The threat of oil spills, in addition to the various other environmental effects associated with the facilities, should be balanced against the need for increased supplies

of oil and gas. In order to reduce the need for new drilling, production from existing wells, both onshore and offshore, should be encouraged to the maximum extent possible by de-regulation of oil prices. To reduce the possibility of major new spills like the 1969 event that occurred on Federal leases off Santa Barbara, the Federal government should also be strongly urged to match the State's stringent requirements, which have thus far prevented any significant spills.

To the greatest extent possible, offshore production should consolidate facilities and use submerged production systems to minimize developments within the coastal zone, and preclude any adverse environmental or aesthetic impacts.

Before any new offshore proposal for drilling is approved, the petroleum company or companies involved should be required to submit long-term plans for development of the lease and related facilities, so that the decisions whether to approve that proposal and others can be made in a full long-range planning context. Applicants should be required to accept strict liability for cleanup costs and damage from oil spills, and to submit a \$10 million bond with the State Lands Division before drilling, and an additional \$1 million bond for each drilled well actually put into production. Such bonds would help to ensure that the best safety and spill prevention technology are used and that oil spill contingency plans are effective.

Perhaps most importantly, development of offshore petroleum resources must be carefully coordinated between California agencies and the U.S. Department of the Interior. Federal leasing of outer continental shelf lands beyond State jurisdiction is not presently subject to the approval of any California agencies. Because Federal offshore



activities may affect water quality and marine life, inadvertently deplete some of the State's reservoirs, pose a greater threat of oil spills, increase the aesthetic impact of more fixed platforms, and lead to significant onshore developments such as refineries, tanker terminals, storage tanks, pipelines, and associated industrial development, applicants for Federal offshore leases should also be required to submit long-term plans of development to the Department of the Interior and the Coastal Commission or its successor agency for approval. In order to cope with the related onshore development and environmental degradation that will occur, California should receive a portion of the revenues from offshore production in Federal waters.

Through careful planning directed at developing the offshore petroleum resource only as it is clearly needed and protecting environmental and ecological values, petroleum production can be made more efficient, safer, and less visible in the coastal zone.

## 2. Siting Tanker Terminals

Because existing tanker terminal capacity can accommodate projected import needs until at least 1985, new or substantially expanded terminals should be permitted only when it can be conclusively shown that there is a need for new capacity that cannot be met elsewhere, that smaller tankers could not feasibly be used, and that the new facilities will be environmentally less damaging than the existing ones.

Eventually (after 1985) California will need new tanker terminals to accommodate its volume of imported crude oil and refined products. Tankers will undoubtedly be much larger in ten years than existing tankers and will require deeper water depths at tanker terminals. No California port can accommodate these huge vessels without extensive

dredging to deepen channels and berthing areas. As discussed in the Marine Environment planning element, however, dredging and filling involves significant adverse effects on marine life and tidal action. Supertankers would also be subjected to congested harbor traffic, with associated risks of oil spills which affect nearshore areas far more than offshore deepwater areas. Therefore, no future tanker terminals should be permitted in existing harbor areas that would require dredging or be near critical biological areas.

Future tanker terminals should be sited in deepwater areas (greater than 80 feet); away from areas of critical biological concern, and out of vessel traffic lanes. Tanker facilities should be used by many companies (instead of a proliferation of facilities for individual users), be sited as close as possible to refineries and power plants to reduce transportation costs, and have ready access to the finest-state-of-the-art equipment for the containment and recovery of oil spills. Tanker owners and tanker terminal operators should assume strict liability for all oil spill damages and should be encouraged to use the most modern and safely designed and equipped tankers available. All of these provisions should result in safe tanker importation of petroleum without substantial adverse effects on the environment.

### 3. Siting of Refineries

California's refineries have been sited within or near major market areas (metropolitan centers) in order to minimize the transportation costs of refined products. Refined products require a greater variety of transportation modes (i.e. tanker trucks, pipelines, dump trucks for asphalt) than crude oil, which leads to large transportation systems and costs. Of the State's 34 refineries, 15 are in the Los Angeles

area, 6 in the San Francisco Bay area, 9 small to medium-sized refineries in Bakersfield, and 4 at scattered sites. All the Los Angeles and San Francisco refineries receive crude oil from both in-State production and tanker terminals handling imports. Hence it is important to locate refineries with concern for proximity to market areas, but also near the sources of crude oil.

Cars, buses, trucks, and other vehicles cause the greatest percentage of air pollution in California, but refineries also contribute significantly to air pollution. Recent studies have linked refinery hydrocarbon emissions with risk of lung cancer in areas immediately downwind of refineries. The health-effects data is not conclusive, but there can be no doubt that refineries significantly contribute to the deterioration of air quality, primarily in metropolitan areas.

The Federal Clean Air Act has led to regulations concerning ambient air quality standards affecting critical air basins (i.e. Los Angeles area, San Francisco Bay area) and "stationary source" emission standards, which affect refineries. Even the new technology of "clean" refineries cannot meet the hydrocarbon emission levels administered by the Environmental Protection Agency and the local California Air Pollution Control Districts (APCDs). As air pollution continues to increase from a multitude of gasoline-burning vehicles and refinery and industrial sites, more people will suffer adverse health effects and the critical air basins will become smoggier and less livable. The net result will be to force new refineries outside of metropolitan areas.

The siting of refineries themselves is not dependent on the coastal zone, because their source of crude oil can be provided by pipelines to an inland site. Refineries should be sited in areas in which prevailing

winds will disperse emissions away from population areas and particularly sensitive natural areas (e.g. prime agricultural land).

4. Siting Liquefied Natural Gas Tanker Terminal and Onshore Facilities

Important new near-term sources of natural gas supply for California include gas produced in southern Alaska, on the Alaskan North Slope, and in Indonesia. The very large volumes of gas available can be economically transported in specially designed ships by liquefying the gas at  $-259^{\circ}$  F. to reduce its volume. After shipping, the liquefied natural gas (LNG) is off-loaded at special docking facilities, stored in liquid form in very large tanks, and changed back into gas in vaporization plants as needed. Facilities and operations for LNG import into California would be located on the coast.

LNG import projects are relatively new to the U.S., two projects having been in operation on the East Coast since 1969. LNG imports to Japan and Europe, however, have been going on for ten years.

The foremost concern regarding planning for LNG import projects is public safety. LNG is difficult to handle because the extremely low temperature at which natural gas is liquefied creates unique stresses on containment materials and results in very rapid vaporization in the event of an escape of LNG. The vapor is highly flammable in open air, and in enclosed spaces mixed with air in certain proportions, it can explode.

Proponents say that LNG is no more hazardous to handle and store than accepted hydrocarbons such as liquid propane or gasoline, that the statistical probability of serious accident is very small, and that the likelihood of an LNG accident affecting people or property off of the plant site is even less. Planning for LNG facilities should,

however, proceed only under the most rigorous safety standards for equipment design, tanker and onshore facilities operations, fire response capability, and emergency evacuation planning. The most important consideration in LNG site selection should be minimization of exposure of population and property to the potential effects of an accident of major proportion.

LNG facilities may involve a variety of potential adverse environmental impacts. Dredging may be required to accommodate the 40-foot drafts of LNG carriers, and to build berthing facilities. At sites on the open coast, pier—and possibly breakwater—construction would be necessary to assure ship safety during off-loading. Where sea water is used in a once-through system to provide heat for vaporization, the plant will discharge a cold-water effluent. Where this may have an adverse impact on marine ecosystems, as in enclosed bays or estuaries where dispersion is poor, it should be avoided.

LNG facilities are presently proposed for Los Angeles Harbor, Port Hueneme, and Point Conception. Viewed in very broad terms, site selection will involve choosing among developed harbor areas, where land use and environmental impacts are small but the possible consequences of accident may be greater, and undeveloped coastal areas, where land use and environmental impacts may be significant, but risk to the public is nil.

#### 5. Siting Power Plants

Power plants for the generation of electrical energy have traditionally been located along the coast to take advantage of the abundant and "free" ocean waters for cooling of the plant, tanker fuel oil transport possibilities, and proximity to the major electricity load centers of the State.

The new State Energy Resources Conservation and Development Commission will have responsibility for determining California's need for new power plants. It will also make decisions regarding acceptable power plant technologies and coastal versus inland siting. The Coastal Commission or its successor agency should, however, retain concurrent jurisdiction over environmental issues relating to power plants proposed in the coastal zone, and therefore have the authority to prevent development of any power plant site that would threaten public health or safety in the coastal zone, damage marine life, pre-empt scenic or recreation areas, or otherwise be inconsistent with the objectives of the California Coastal Zone Conservation Act of 1972.

When sited in the coastal zone, both nuclear and fossil fuel power plants create public health and safety problems, have adverse environmental and ecological effects, and pre-empt other land uses.

Nuclear power plants involve hotly debated public health and safety issues. Nuclear plants do not produce air pollutants, and that is a distinct advantage in California, where air pollution problems are already severe in the most populous air basins. However, a serious accident at a nuclear plant resulting in release of radioactive materials could endanger the lives of thousands of people. The risks of such an accident are low but are markedly increased if nuclear plants are sited in areas of potential seismic activity. Many areas of the California coastline lie in seismic risk areas (see the Geology planning element) and are therefore unsuited to nuclear power plant siting.

Many other coastal areas are too close to existing populations to be suitable for nuclear plants under regulations of the Atomic Energy Commission. When nuclear power plants are allowed to be sited in the

coastal zone, adequate emergency evacuation plans should be developed for nearby populations, and steps must be taken by local governments or by the electric utility to prevent subsequent population influx into the area of possible radiation hazard. Nuclear plants also present serious problems of radioactive waste handling, transportation, and storage, and sabotage or theft possibilities.

Nuclear plants already operating or in the process of being constructed along the California coast utilize "once-through" cooling systems, in which cold ocean water is pumped through the plant to absorb the waste heat, and then is pumped again into the ocean. A once-through cooling system for a standard-size nuclear reactor unit (about 1,000 Mw) circulates large volumes of water through the plant. Significant quantities of marine life are inevitably trapped and killed at the cooling system intake points or drawn into the cooling system, exposed to high temperatures and killed. And the heated water discharge raises local ocean temperatures, further affecting marine life.

There are alternatives to once-through cooling systems. Use of closed-cycle evaporative cooling towers, which can be designed to use either fresh water or sea water, avoids the damage to marine life caused by once-through systems. Cooling towers, however, do not merely circulate water; they consume water through evaporation. In California, because fresh water supplies are scarce in some areas, some people believe that fresh water should not be used for waste heat cooling at power plants, and that power plants should therefore use ocean waters for cooling. While agricultural and municipal uses of fresh water should always be guaranteed first priority, a number of studies conclude that presently available inland fresh water supplies for California are

adequate to cool new power plants needed during the next 20 years. In addition, experts now believe that cooling towers can use re-treated municipal and agricultural waste waters. These facts, coupled with the impending commercial availability of new "dry" or "dry-spray" cooling tower technology which require negligible water and which substantially reduce water consumption, make inland power plant siting a reasonable alternative to coastal siting, particularly if the utilities were to assist in defraying the costs of inland water reclamation projects.

All but three of the power plants presently in the coastal zone are fossil fuel plants. These plants do not present the safety problems of nuclear power plants in the event of an accident; and therefore seismic risk is not as significant a factor in siting fossil plants. However, fossil fuel plants emit significant quantities of oxides of sulfur and nitrogen, which create air pollution and are a significant public health hazard. Most fossil fuel plants are more efficient than nuclear plants and consequently produce less waste heat per unit of electricity produced, and require less cooling water. However, the consequences to marine life of using once-through cooling systems at fossil plants are also severe. Because of the smaller water requirement and the disposal of some waste heat through tall stacks, fossil fuel plants can be cooled with cooling towers and sited inland with greater ease. Fossil fuel power plants should be designed and located to minimize the air pollution hazards to human populations, minimize or eliminate damage to marine life, and minimize land use conflicts in the coastal zone.

There are very few remaining coastal sites suitable for power plants, but potential inland sites are relatively numerous. Noncoastal areas with sufficient cooling water can be chosen for power plants away from seismic risk areas and population centers, thereby removing the



safety hazard from cities, the air pollution problems from dangerously polluted air basins, the potential for adverse impact of once-through cooling systems on fragile marine ecosystems, and land use conflicts within the narrow coastal zone. All these considerations make siting at inland locations generally preferable to coastal siting, whenever possible.

No new power plant sites or power plant expansions at existing coastal sites, therefore, should be permitted in the coastal unless no inland sites are available that have adequate cooling water and that are otherwise environmentally acceptable.

#### 6. Alternative Energy Sources

Hydroelectric generation facilities require huge volumes of water stored behind dams, which involves substantial loss of land by inundation. Dams can also deprive down-river areas of the natural flooding processes that deposit new sediments and continue natural erosion and sand transport to beaches (as outlined in the Coastal Land Environment planning element). However, dams can also provide needed recreation areas for boating, fishing, etc. The need for future hydroelectric facilities can be reduced by using pumped hydroelectric power instead of constructing massive new dam complexes.

While geothermal power poses some pollution problems that require careful control, in general it is relatively non-polluting and does not consume scarce fossil fuels. The principal environmental concerns about geothermal power center on air pollution from hydrogen sulfide, the classic "rotten egg" smell, the occurrence of land subsidence under depleted reservoirs, the possibility of radioactive radon leakage, and stream pollution from sulfur and soil runoff. Most of the 35 "known

geothermal resource areas" in California are outside the coastal zone and in unpopulated rural areas.

Solar energy is inexhaustible in supply, does not involve consumption of fossil fuels, and probably poses the fewest environmental problems of all the major sources of energy. There are major problems with its use, however. Though all of the prime solar collection areas in California are away from the coastal zone, they would use many square miles of desert or semi-arid land for large commercial solar plants. In addition, solar plants would require large volumes of cooling water, which could be difficult to obtain in semi-arid areas. However, the Los Angeles Energy Planning Council is examining the possibility of locating an experimental electricity generation solar plant in the nearby desert.

One use for solar energy that is feasible today and that could significantly reduce natural gas and electricity consumption is water heating and home heating and cooling. For example, in Florida today, about 60,000 solar hot water heaters are in use which were installed in the 1930s and 1940s before the advent of all-electric homes. The principal barriers to the use of solar energy have been institutional and economic. With the rise of other fuel prices, however, it is now economically competitive to use solar energy for heating and cooling.

Solid wastes have a large potential as an energy source as well as the advantage of greatly reducing waste disposal problems. Solid wastes can be burned directly to produce steam for heat and power or can be converted to oil or gas for a variety of uses. For example, refuse could furnish about 10 percent of the fuel needed by utilities or serve as a source of gas for residential customers. In other parts of the country wastes are already being used to generate electricity.

Wind energy facilities offer a romantic memory out of the past of windmills, but such facilities seem to offer only modest potential as major power plants. Large wind energy facilities would require considerable land areas and have a visual impact. Both of these characteristics probably preclude such facilities in the coastal zone. On the other hand, there is considerable potential for individual windmill units. These could make single buildings or small building clusters nearly energy self-sufficient if used in conjunction with new energy storage techniques presently being developed. This would again reduce overall energy demand for non-renewable fossil fuels and electricity.

Tidal power is enormous and constantly replenishable, but harnessing it would require massive installations along many miles of the coast, with such minimal energy potential that its development is not warranted.

There is also growing interest in nuclear fusion. Nuclear fusion facilities would present several public safety hazards in the event of an accident, but other environmental effects would be negligible. However, nuclear fusion technology is decades away. Cooling requirements would be reduced, and land use considerations would allow siting of facilities almost anywhere in the State--most likely away from population centers.

New methods to store energy are also being developed. For example, hydrogen fuel cells are presently planned for operation in 1978 by the Southern California Edison Company, but widespread commercial use seems decades away. Fuel cells would require small land areas and few environmental effects. Storage batteries are also an important method of storing electrical energy, particularly in conjunction with such new sources of energy as wind or solar.

### The Question of Life-Styles

While the potential for energy conservation is significant (we could halve our energy growth rate without affecting our quality of life or economic growth), and the technology to minimize many of the environmental impacts is largely available, the fundamental issue in "energy and the coastal zone" is our way of life. If we consider all together the many issues involved in meeting continued energy demand growth—environmental protection, economic growth, international economics and political stability, resource utilization, quality of life—we must confront head-on the issue of whether life-styles in California must change in response to the increasing difficulties of supplying energy for consumption at ever-increasing per capita rates.

At present, virtually every aspect of life in California is predicated on a cheap, plentiful, and unlimited supply of energy. It is now apparent to many, however, that although the short-run benefits of having cheap energy for unbounded individual use are highly visible and very seductive, the longer-run consequences both to collective society and ultimately to individuals are serious.

Alternative patterns of life designed to consume less energy are now being seriously proposed—and seriously received—for the first time. Such proposals should not be unduly alarming. They are based on such ideas as a society that is services-oriented rather than goods-oriented; greater attention by industry, government, and individuals to recycling of products; new energy-conserving patterns of recreation and transportation; new emphases in architectural design on community living and working; and perhaps a "reduced pace of life". For example, we would have to become accustomed to smaller cars and public transportation,

and to walking more and driving less; we would be slightly cooler in the winter and warmer in the summer; and we would turn off lights as we leave a room and consume fewer throw-away articles.

Such ideas are aimed at achieving a consciousness about energy that is similar to that for money and a higher quality of life for all by eliminating some of the many problems associated with today's "good life". They are also ideals that help to illuminate the idea that sooner or later a point may be reached where we have enough energy, where further annual increase in energy consumption would be minimal. At the same time these proposals could improve the energy income of the poor. Conserving measures such as effective mass transit and residential complexes with total energy systems could actually result in better services, lower long-run energy prices, and a higher standard of living for the poorer income groups. The need for large new energy complexes in the coastal zone would also be substantially lessened.

### Conclusion

California's energy situation is complex. Its impact upon the coastal zone is extensive. A new look at future energy demand, tempered by price increases and conservation practices, can reduce the need for some of the additional energy generation capacity previously anticipated. And a fresh and dedicated approach to alternative energy sources can further reduce the impact of energy production upon the environment. Through a statewide perspective and program for the conservation and supply of energy, the coastal zone can be preserved and wisely developed while ensuring California an adequate and clean supply of energy.

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