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*The **FUELS REPORT** is prepared in response to legislative requirements specified in Public Resources Code Section 25310(a). The statute calls for the California Energy Commission to submit to the Governor and Legislature a comprehensive report on historic trends and long-range forecasts of the demand, supply and price of petroleum and petroleum products, natural gas, coal, and synthetic and other fuels. The report also must include specific recommendations for legislative or administrative actions needed to maintain sufficient, secure and affordable fuel supplies for the state.*

ACKNOWLEDGEMENTS

FUELS REPORT December 1989

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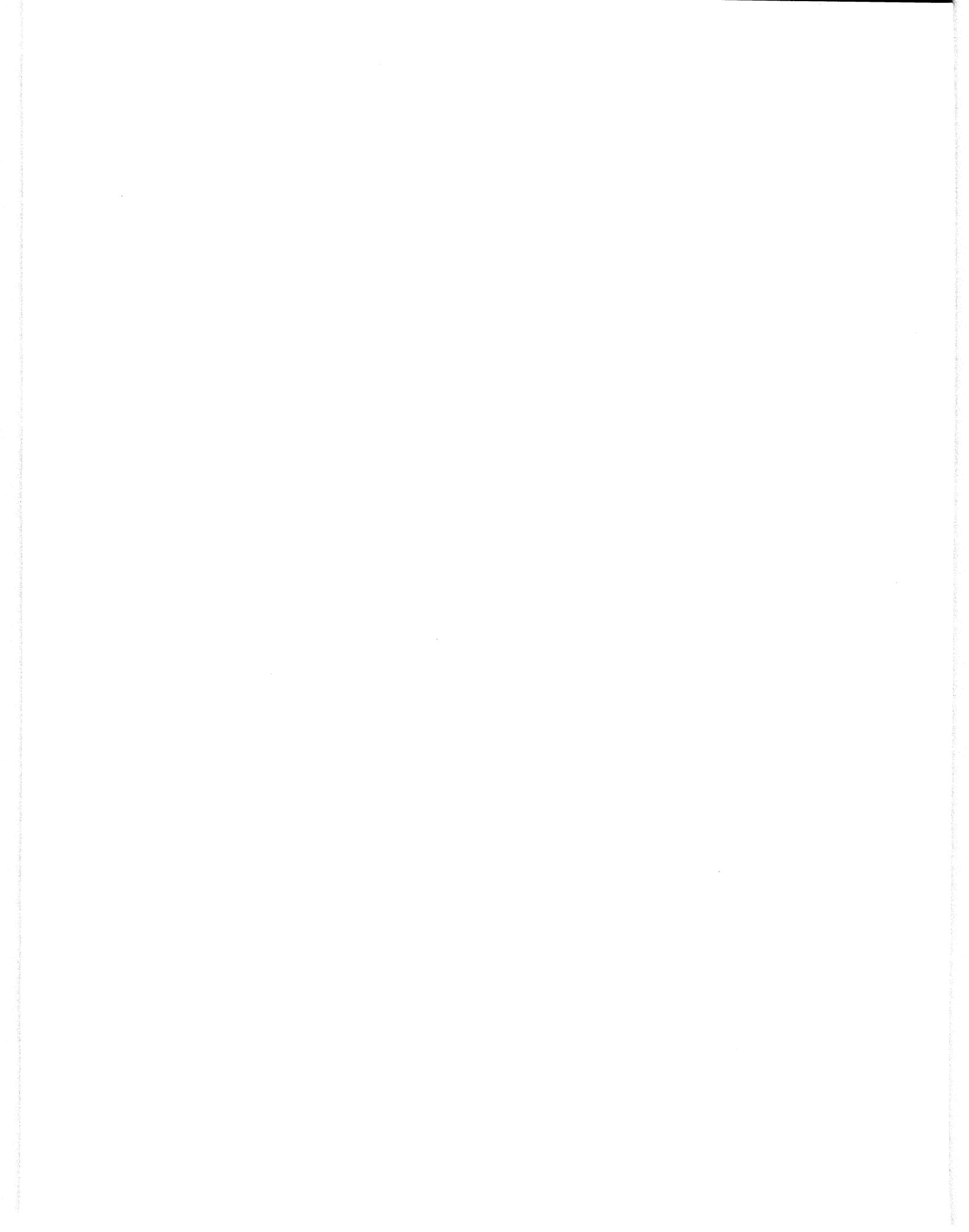
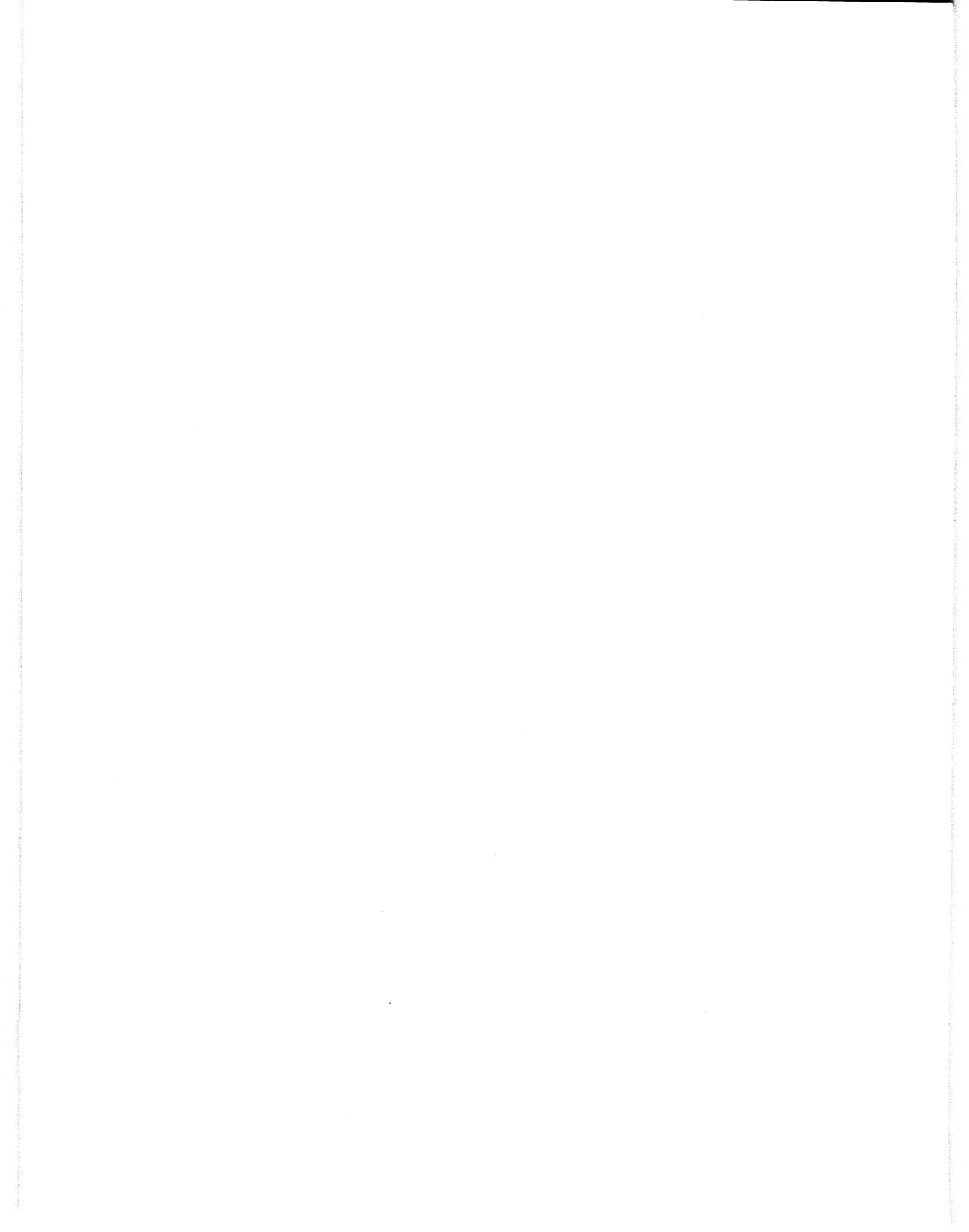


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EXECUTIVE SUMMARY

Energy and Environment: Inseparable Problems

Many environmental problems, from urban air pollution to the possibility of global warming due to the "greenhouse effect," are intimately linked to energy use, principally combustion of fossil fuels. Energy and environmental policies, however, historically have been formulated largely independent of each other. In particular, neither the environmental impacts of energy use nor the costs of reducing those impacts have been systematically included as a cost of energy use. Society must find ways to reduce the environmental impacts of energy use, while still satisfying its need for adequate, secure and affordable energy.

Air quality fails to meet regulatory standards in much of the state, including all major urban areas. The bulk of the urban air pollution is due to use of fossil fuels, particularly oil used in transportation. In 1987, cars and trucks alone accounted for 43 percent of the hydrocarbons, 57 percent of the nitrogen oxides, and 82 percent of the carbon monoxide emitted into urban air statewide.

Besides being a key contributor to air pollution, oil is a cause of concern about the future price of energy and the security of energy supply. Oil prices may remain highly volatile over the next few years. Moreover, the long-term trends of oil and natural gas prices are highly uncertain. Oil imports, now approaching 50 percent of total U.S. oil supplies, are likely to continue growing for the duration of the century. As the nation's oil imports rise so do the risks to the economy from

potential oil market disruptions. Tightening oil markets worldwide may permit the Organization of Petroleum Exporting Countries (OPEC) to regain a measure of its previous control over oil prices.

Given that energy and environmental issues are inextricably intertwined, successful energy policy requires an integrated perspective. Viewing energy or environmental issues separately risks conflicts between the two that are avoidable. Happily, there are many opportunities for actions that simultaneously improve both the energy and environmental situations.

This report explores some of those opportunities in the areas of substituting cleaner fuels for oil, improving transportation systems, and improving fuel efficiency in electricity generation. The report discusses how economic incentives can play a valuable role in taking advantage of these and other opportunities.

Recommendations:

- *The California Energy Commission should strive for public support and a broad agreement on policies and actions to make the major changes in energy supply and end use necessary to reduce the environmental impacts associated with that energy use. Making these changes will require close coordination among energy and environmental agencies at all levels of government, working in cooperation with industry and affected interest groups.*

- *The Energy Commission should work with public and private organizations to increase public understanding of the tie between energy use and environmental consequences. This education program should present realistic and workable opportunities for individuals and institutions to change their energy use patterns and improve their environmental performance. These opportunities must be equitable and cost-effective.*
- *The Energy Commission should encourage all parties involved to address and resolve all outstanding issues so that orderly development of new North American onshore supplies may proceed in an environmentally safe manner.*

Oil and Gas Price Scenarios

Global energy markets are major determinants of energy prices in California. The Energy Commission, recognizing the difficulty of accurately predicting oil prices, has developed alternative oil and gas price scenarios. The scenarios represent two possible ways that future global energy markets could develop, focusing on the implications of those possible futures for oil and gas prices. Scenarios provide a framework to think about the future in disciplined and creative ways, and to test possible outcomes from current conditions and actions.

The RESURGENT OPEC SCENARIO assumes that OPEC develops strategies that suppress nonOPEC oil production and alternative fuels and technologies, as well as inhibit conservation efforts and efficiency improvements. Complementary developments in international political and trade relations enable OPEC to dominate the world oil market and steadily increase oil prices. By contrast the GLOBAL ECONOMIC COOPERATION SCENARIO assumes that policy decisions by oil consumers, particularly in the areas of free trade and the environment, are the strongest determinants of energy prices. These policies, in conjunction

with technological innovations that increase energy efficiency, stabilize oil prices at relatively low levels.

Future fuel prices could be much different if the world were to unfold as depicted by the RESURGENT OPEC SCENARIO than if the world were to look like the GLOBAL ECONOMIC COOPERATION SCENARIO. By the year 2010, oil prices could be as much as twice as high in the former than in the latter scenario. The relationship between oil and gas prices could also be strikingly different between the two scenarios. In the RESURGENT OPEC SCENARIO, gas prices could remain lower than oil prices indefinitely. In the GLOBAL ECONOMIC COOPERATION SCENARIO, in contrast, gas prices tend to rise above oil prices in the long term.

Both views of the future are plausible, yet they are very different. The value of scenarios comes from the use of this insight as a planning tool. Fuels policies and decisions will be strengthened if they are judged against the issues and background provided by the fuel price scenarios.

Recommendations:

- *The Energy Commission should not only monitor, but actively participate in worldwide efforts for cooperative policies concerning energy and environmental issues.*
- *The Energy Commission will continue to increase its efforts to understand the developing competitive natural gas market, including the economic factors that will affect price and long-term planning implications for the state.*
- *The Energy Commission will continue to expand the scenario planning activities for oil prices and expand the planning technique to other fuels and energy resources.*
- *The Energy Commission should support the development of domestic oil resources due to increasing U.S. imports.*

The Importance of the Natural Gas Pipeline System

Substituting natural gas for oil is expected to play a key role in cleaning the air while simultaneously reducing threats to energy security due to imported oil. By increasing the demand for natural gas in California, however, environmental concerns also increase the need for additional gas pipeline capacity for delivering gas to the state. There is an emerging consensus in California that additional pipeline capacity will be needed in the 1990s.

Several proposals now exist to build new pipelines to California from various regions in Western Canada, the Rocky Mountains, and the U.S. Southwest. The Energy Commission has analyzed which potential pipeline configurations provide the greatest benefits to California gas consumers. The Commission concludes that:

- New interstate pipeline capacity will provide significant economic benefits to all California gas consumers.
- Improved access to the Rocky Mountain supply area is a key ingredient in obtaining economic benefits.
- Rocky Mountain gas offers benefits which are not available from other regions.
- Alberta gas resources play a significant role in the California gas market.
- British Columbia gas supplies should be accessed for California's benefit.
- Coal seam gas from the San Juan Basin will provide an important new source of natural gas supply for the California gas market.
- Expansion of capacity in existing pipeline corridors will also provide significant economic benefits.

- New pipelines serving the enhanced oil recovery (EOR) market in Kern County will also afford benefits to consumers in Northern and Southern California, provided that facilities are available to transport the gas from Kern County.

These and other Commission conclusions are discussed in greater detail in the chapters that follow.

Recommendations:

- The state should move to eliminate all administrative barriers to the entry of new pipelines as quickly as possible.*
- The state must continue encouraging improved access to Alberta and British Columbia gas supply regions and coal seam gas from the San Juan Basin.*
- For diversity, security and enhanced gas competition, direct access to the Rocky Mountain region should be acquired. The Energy Commission will continue to monitor the progress of additional interstate pipelines.*
- Market forces should be allowed to determine interstate pipeline projects for access to new supply regions and to increase access to existing supply regions.*
- The expansion of intrastate systems and existing interstate routes should be encouraged.*
- Intrastate facilities which give all consumers access to gas delivered to the Kern County area should be encouraged.*

Impacts of Efficiency Improvements on Utility Power Plants

A group of new and emerging technologies provides a highly efficient means to generate electricity from natural gas and helps meet environmental goals. These technologies are power plants based on a group of advanced combustion turbines called aeroderivatives, originally developed for the aircraft industry. Upcoming technology advances are expected to permit electricity generation efficiencies of 55 percent or higher, compared to 33 percent efficiency for older gas-fired utility power plants.

The efficiency with which a thermal power plant produces electricity is of great importance, especially when the primary fuel source is a nonreplaceable fossil fuel. Energy resources are depleted more quickly and pollution levels are higher than necessary when power is generated less efficiently than the highest levels available with current technology.

Aeroderivative turbines have demonstrated high availability and reliability. Other desirable characteristics include modular construction and smaller sizes, which further increase their overall reliability and contribute to reductions in electricity costs. These advanced combustion turbine designs are well-suited for use in new installations as well as for retrofitting or replacing older, less clean-burning, more expensive-to-operate power plants. They are inexpensive enough to be run in continuous baseload operation, and yet are flexible enough to be used for load following and peaking applications.

The Commission staff is examining an aeroderivative turbine cycle configuration that holds substantial promise of very high efficiency as well as extremely low pollutant emissions. Analysts believe that this technology will achieve an efficiency greater than 55 percent, while producing nitrogen oxide and carbon monoxide emissions substantially below currently mandated levels, even without post-combustion pollution controls. Nitrogen

oxide emissions should be 70 times less than a simple cycle gas turbine. The equipment options necessary to exploit this promising technology already exist and are in separate use; the remaining challenge is to combine these options to demonstrate that the actual performance meets the theoretical expectations.

Recommendations:

- The Energy Commission should continue to investigate methods to incorporate advanced combustion turbine technologies into California's electric power generation system.*
- The Legislature should provide funding for demonstration projects for high efficiency combustion turbines.*
- California electric utilities should participate with the California Energy Commission in testing and demonstrating the feasibility of high efficiency combustion turbines.*

Fueling Transportation in California

Oil use in transportation is a central focus of both environmental and energy problems, and the most visible link between policies in the two areas. Meeting the growing demand for transportation fuels while pursuing long-term alternatives to petroleum occupies an increasing priority for state energy planning. At the same time, goals for improving both regional and global air quality require substantial further reductions in air pollution emissions from all transportation sources.

A growing state population and a growing economy point to the likelihood of a steady increase in transportation energy requirements for the foreseeable future, with little prospects in sight of anything to challenge the supremacy of oil use. Approaches to improving transportation include taking advantage of a range of energy sources and vehicle efficiency

improvements, as well as changes in land use patterns and individual transportation practices. We must proceed on all fronts if California is to secure a future transportation system with desirable environmental, energy and economic characteristics.

The principal fuel alternatives to today's gasoline and diesel fuel are reformulated gasoline and diesel, methanol, ethanol, compressed natural gas (CNG), propane, electricity and, in the very long-term, hydrogen. No economic incentive exists for appreciable use of any of these alternatives in the United States today, and current use remains negligible. By the year 2000, methanol, CNG, propane and electric vehicles could be competitive with gasoline and diesel vehicles in some applications. But because of the time lags involved, anything that can be done in the near-term to improve the efficiency and cleanliness of gasoline and diesel engines will have the most impact on both the environment and energy security.

In addition to developing alternative transportation energy sources, there is a critical need to control fuel demand growth. Present fuel prices provide little restraint on driving habits. The potential for increasing vehicle fuel efficiency through improved technology or a shift to more efficient vehicles is very large. As one means of tapping this potential, the Energy Commission has previously recommended that federal average mileage standards, currently 27.5 miles per gallon, be increased to cost effective levels, based on newest technologies. Transportation demand management programs — such as ridesharing, mass transit, flexible work patterns, parking restrictions and substituting telecommunications for travel — should also be vigorously pursued. However, no combination of actions has yet been set forth that promises an adequate solution.

Recommendations:

- The Energy Commission should urge California's congressional delegation to support legislation that would allow California to set its own higher vehicle fuel economy standards.*
- The Energy Commission should pursue incentive strategies at both the federal and state level that penalize high emission or poor fuel economy vehicles and reward vehicles that demonstrate both low emissions and high fuel economy.*
- The Legislature should provide increased funding for fleet demonstration projects for CNG, electric vehicles and alcohol fuels.*
- California's gas utilities, automotive companies and private fleet owners should participate with the Energy Commission in CNG demonstration projects.*
- The Department of General Services should adopt a goal of converting the state's vehicle fleet to low-emission, high fuel-economy vehicles.*
- The California Department of Transportation should implement a pilot program to assess the potential of instituting user fees on portions of the state's highway system.*
- The State of California should pursue an integrated approach to transportation policy that jointly considers energy, environmental and economic goals. To aid in this effort, it is necessary for the State to expand and consolidate its capability to compile and analyze data on future energy and transportation needs.*

Economic Incentives as Environmental Policy Tools

In many cases, economic incentives provide more efficient and effective means than traditional regulatory approaches for dealing with utility regulation and with pollution and other environmental ills. The traditional regulatory approach relies on setting and enforcing uniform rules or standards. In contrast, economic incentives channel the self-interest of individuals in directions that further the public interest. Government entities establish public objectives, such as measures of utility performance or environmental quality, and allow people to find the best way to meet those objectives.

The use of economic incentives has several advantages over the traditional command-and-control approach. A well-designed economic incentive system gives affected people both the incentive and the flexibility to choose the lowest cost and fastest methods to achieve the desired public objective, as well as to adjust the methods as conditions change. Economic incentives harness private ingenuity to achieve the public objective, thus promoting innovation. Economic incentives can motivate people to go beyond the requirements of regulatory standards. Use of economic incentives can considerably reduce the knowledge and enforcement burdens on regulators and permit them to focus on goals rather than details.

Economic incentives may be particularly useful for dealing with transportation problems because individuals now have little incentive to control fuel use or vehicular pollution. This report discusses a range of economic incentive options for transportation.

Recommendations:

- The Legislature should provide increased funding and direction for research and implementation of incentive strategies that provide an integrated solution to air quality and energy problems.*
- The California Air Resources Board and local air quality districts should increase their emphasis and reliance on market-based incentive strategies to attain air quality goals.*
- The Energy Commission should develop a set of economic incentives to control transportation-related emissions and fuel use.*

CHAPTER 1

ENERGY AND ENVIRONMENT: Inseparable Problems

Energy is an essential component of all economic activity. Yet almost all energy production and use is harmful to the environment to some degree. Energy and environmental policies, however, historically have been formulated largely independently of each other. In particular, neither the environmental impacts of energy use nor the costs of reducing those impacts have been included as a cost of energy use. Now, increasing public concern about the societal costs of pollution have focused government and industry attention on the connections between energy and the environment.

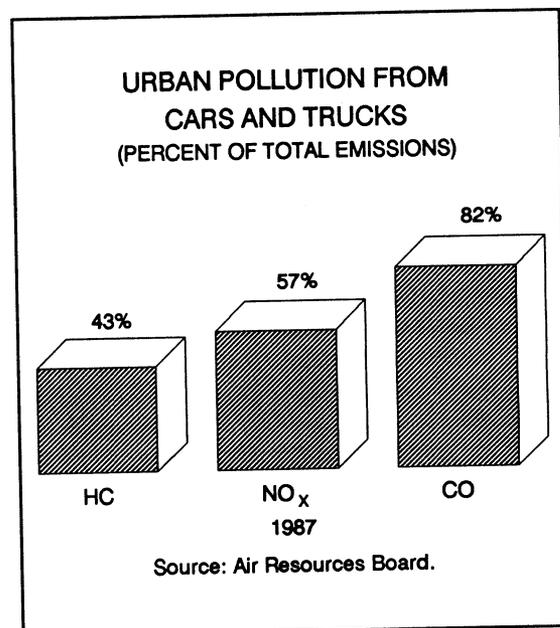
Society must find ways to reduce the environmental impacts of energy use, while still satisfying its need for adequate, secure and affordable energy.

Urban air pollution, acid rain and the possibility of global warming due to the "greenhouse effect" are intimately linked to energy use, principally combustion of fossil fuels.

In 1988, the California Legislature passed a bill calling for the Energy Commission, in cooperation with other state agencies, to study and report by June 1990 how global warming trends may affect the state's energy supply and demand, economy, environment, agriculture and water supplies. The Commission found in a June 1988 Interim Report to the Legislature "that the risks and consequences of global

warming are great enough to warrant a thorough examination of possible policy measures for delaying or preventing further warming, as well as policies to prepare the state for warming that may come in any event."

Air quality fails to meet regulatory standards in much of the state, including all major urban areas. In the summer of 1987, state ozone standards were exceeded on 90 percent of the days in the South Coast Air Basin and over 50 percent of the days in San Diego and Fresno. The bulk of the urban air pollution is due to use



of fossil fuels, particularly oil used in transportation. Cars and trucks alone accounted for 43 percent of the hydrocarbons, 57 percent of the nitrogen oxides, and 82 percent of the carbon monoxide emitted into urban air statewide in 1987.

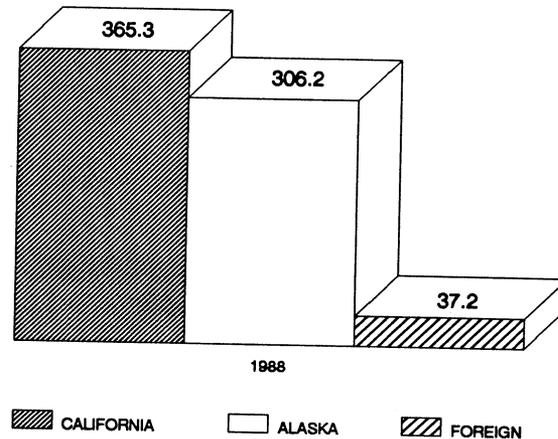
Besides being a key contributor to air pollution, oil is a cause of concern about future energy prices and the security of energy supply. U.S. oil production has been dropping since 1986 and is likely to continue to drop. Some experts expect Alaskan oil production to drop to half or less of its current level by 2000. Much oil may yet be discovered in Alaska, but economic uncertainties and serious unresolved environmental concerns will inhibit its discovery and production.

Increasing oil demand and decreasing production in the U.S. will lead to significant increases in oil imports. Forty-three percent of oil consumed in the U.S. was imported in 1988, at a cost of \$42 billion. One U.S. Department of Energy scenario suggests that oil imports may exceed 50 percent of total U.S. oil use within the next three years, with the nation's annual bill for imported oil rising to over \$100 billion by the year 2000. As the nation's oil imports rise, so do the risks to the economy from potential oil market disruption.

Most of the oil in the U.S. is used in transportation; in California the figure is about three-quarters. Since 1982, transportation energy use in the state has increased more than five percent per year. Despite the lowest gasoline prices in nearly a decade (much longer, if one corrects for the effects of inflation), the average California household spent much more on gasoline in 1988 than on either electricity or natural gas.

Oil use in transportation is a central focus of both environmental and energy problems and the most visible link between policies in the two areas.

CALIFORNIA OIL SUPPLY SOURCES (MILLIONS OF BARRELS)



Source: California Energy Commission.

ESTABLISHING AN AGENDA

Energy and environmental issues are inextricably intertwined; successful energy policy requires an integrated perspective. Viewing energy and environmental issues separately risks conflicts between the two that are avoidable. There are many opportunities for actions that simultaneously improve both. Some of the best opportunities fall in the related (and partially overlapping) strategies of substituting cleaner fuels for oil, improving transportation systems, and improving fuel efficiency in electricity generation. Market mechanisms can play a valuable role in taking advantage of these and other opportunities.

Substituting Cleaner Fuels For Oil

Substituting cleaner fuels for oil can clean the air while simultaneously reducing threats to energy security. The greatest opportunities in the near and mid-term exist with natural gas. Gas is an abundant resource in North America and elsewhere, competitively priced and easy to substitute for oil in most stationary (nonmobile) uses, such as boilers and turbines. Some other alternatives for substituting cleaner fuels for oil

— including methanol, ethanol, propane and electricity — are currently focused on transportation and stationary applications. Pollution from transportation can also be reduced by reformulating gasoline and diesel fuel to make them burn more cleanly; although this does not by itself help reduce dependence on petroleum.

Despite the generally optimistic outlook for natural gas supply and price, a scenario of sharply increased gas use raises issues warranting careful continued attention. Future oil and natural gas prices are highly uncertain and the past relationship between oil and gas prices may not hold in the future. Some industry watchers expect that gas may command a significant price premium over oil, as environmental considerations drive up the demand for gas and restrict the ability to switch from gas to oil. Chapter 2 describes two oil and gas price scenarios over the next 20 years. These show that considerable price uncertainty exists and that it would be unwise to make premature assumptions about future gas and oil prices.

Another concern is whether adequate gas supplies will be available. Even with a large resource base, maintaining ample supplies requires timely drilling of gas wells and construction of additional pipeline capacity. With a gas surplus and relatively low gas prices

over most of the 1980s, drilling has not been sufficient to prevent a decline in deliverable gas supplies.

As gas supplies tighten, market demand will cause prices to rise (wellhead prices are now deregulated), thus stimulating more drilling for gas. Gas prices can be expected to rise to the level necessary to cause supply and demand to balance. A lag of up to several years can, however, exist from the time that gas producers start looking for gas until the gas is ready for market.

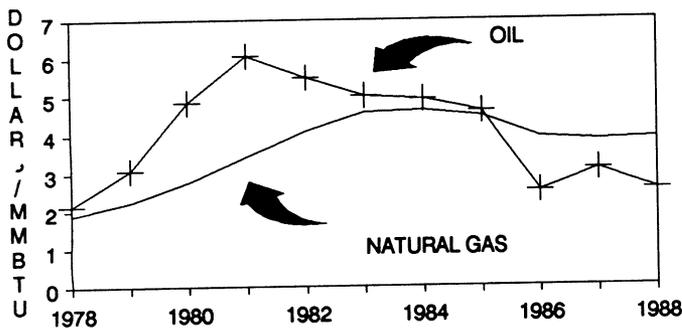
The specter of tighter gas supplies and increased gas demand increase the importance of the pipeline system that delivers gas to California. Choices made now regarding the addition of new interstate capacity will significantly affect the cost of gas to California consumers for years to come. Additional pipeline capacity from new and existing supply areas could yield very large dividends in the form of lower gas costs. New pipeline capacity would also provide an increased level of gas service reliability. This higher level of service will be required to support key environmental initiatives that rely on increased gas use.

Improving Transportation Systems

Transportation is the largest energy-use sector in California and the major source of air pollution. Transportation presents special difficulties whether viewed from the perspective of energy goals or environmental goals. This is due in part to the sheer magnitude of California's transportation system.

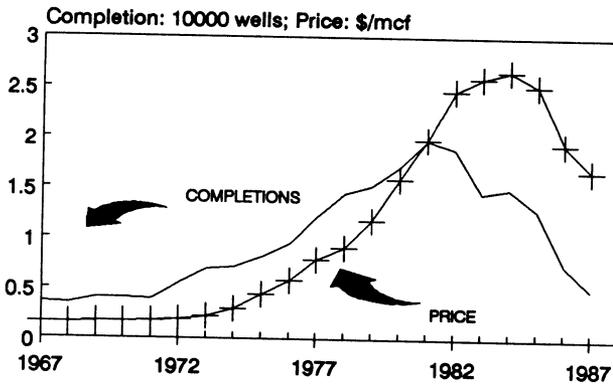
Changing the transportation system requires dealing with land use planning, lifestyles, changing demographics, the central role of transportation in the economy, and the current lack of adequate alternatives to the private automobile. With transportation fuel use increasing rapidly, it is necessary to work harder just to stay even.

**HISTORIC OIL AND
NATURAL GAS PRICES
(NOMINAL DOLLARS)**



Source: U.S. DOE/EIA.

GAS WELL COMPLETIONS AND WELLHEAD PRICES



Source: U.S. DOE/EIA.

Some approaches to improving transportation include:

- taking advantage of a range of energy sources and vehicle efficiency improvements
- changing land use patterns
- changing individual transportation practices

These efforts must proceed if California is to secure a future transportation system with desirable environmental, energy and economic characteristics.

The principal fuel alternatives to today's gasoline and diesel fuel are reformulated gasoline and diesel, methanol, ethanol, CNG, propane, electricity, and, in the very long-term, hydrogen. No economic incentive exists for appreciable use of any of these alternatives in the United States today. By the year 2000, methanol, CNG, propane and electric vehicles could be competitive with gasoline and diesel vehicles in some applications. The California Advisory Board on Air Quality and Fuels recently issued a report to the Legislature that further discusses alternative fuels and their air quality impacts.

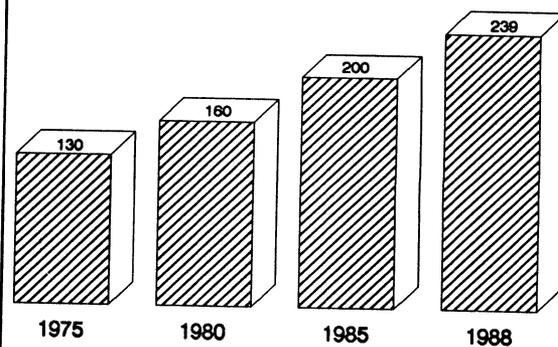
In addition to developing alternative transportation energy sources, controlling fuel

demand growth is critical. There is great potential for increasing vehicle fuel efficiency. As one means of tapping this potential, the Energy Commission has previously recommended that federal corporate average fuel economy standards (CAFE), currently 27.5 miles per gallon, be increased to cost-effective levels, based on newest technologies. Transportation demand management programs, such as ridesharing, mass transit, flexible work patterns and substituting telecommunications for travel, should also be vigorously pursued.

The role of state government in helping to solve transportation problems should be defined immediately. The state should go beyond its traditional role of creating effective policies and play an active role in catalyzing and supporting programs that span the range of approaches for improving the transportation system. This role should include analysis and information dissemination, research, demonstrations of technologies and other direct funding activities.

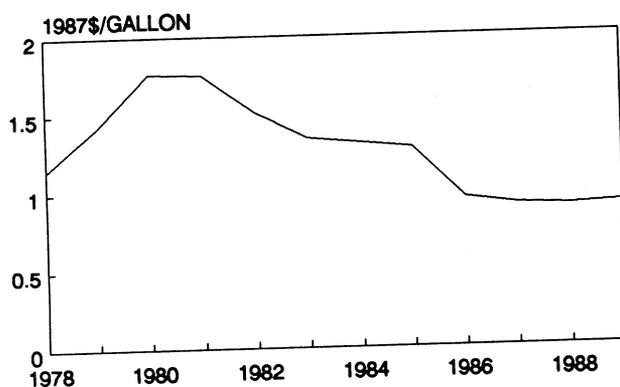
Existing state and federal regulatory authority over air pollution and energy affect transportation. Current regulations rely heavily on enforcing uniform control standards. These regulations tend to ignore economic incentives that encourage rather than force changes in transportation behavior. Although the best mix

VEHICLE MILES TRAVELLED IN CALIFORNIA (BILLIONS OF MILES)



Source: Caltrans.

CALIFORNIA GASOLINE PRICES (REGULAR UNLEADED/SELF-SERVE)



Source: Lundberg Survey Inc.

of standards and incentives is still a question, the optimum solution will be a combination.

Currently, drivers have little economic incentive to save fuel or reduce pollution. Fuel costs are a small fraction of total driving costs (nine percent in 1988). Many options exist for economic incentives to reduce transportation fuel use. Possibilities include surcharges on low-mileage vehicles, highway user fees and higher fuel taxes.

Current automotive emissions standards are expressed in terms of grams of pollutants emitted per mile driven. These standards have major disadvantages. First, grams-per-mile standards provide no incentive to drive less and no limit on total permissible emissions, either per person or for the total population. The more people drive, the more they are allowed to pollute. Second, fuel-efficient cars are allowed to pollute as much as inefficient cars. Manufacturers simply expend less effort in controlling emissions from fuel-efficient ones, because they lack an incentive to do better. Thus, an opportunity is wasted for relatively easily achievable emissions reductions. Fuel emission standards that relate to fuel efficiency would help, but drivers still would have little incentive to choose less-polluting fuels or vehicle types.

One method to provide economic incentives for transportation emissions reduction is a

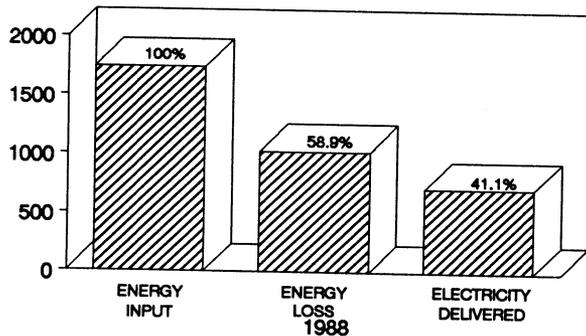
per-gallon tax on fuel that varies by fuel type, with cleaner fuels having a lower rate. Such a program in the United Kingdom in the summer of 1989 greatly accelerated the introduction of unleaded gasoline. If the tax were based on estimates of actual environmental costs from burning that fuel, it would internalize environmental costs. Another incentive for emissions reduction is to base an annual vehicle registration fee on the actual emissions measured during mandatory yearly inspections. Other incentive options include retiring old high emission vehicles (a highly successful program in Sweden), tax rebates based on emission levels, and an emission trading program for vehicle fleets or sellers of new vehicles. A combination of these and other incentives could be adopted to complement more traditional emission standards.

Improving Electricity Generation Fuel Efficiency

Utility use of fuel to generate electricity is another area providing opportunities to advance energy and environmental goals simultaneously. New and emerging technologies that provide a highly efficient means to generate electricity from natural gas are discussed in Chapter 4. These technologies are power plants based on a group of advanced combustion turbines called aeroderivatives, developed for the aircraft industry. Upcoming technology advances, when commercialized, are expected to permit electricity generation efficiencies of 55 percent or higher, compared to older gas-fired utility power plants typically in the 30 to 34 percent efficiency range.

These new technologies have the potential for an even greater percentage reduction in air emissions than in fuel use. Consequently, the new electricity generation technologies are attracting attention as a possible technique for meeting air quality goals, particularly in Southern California. Some of the existing 7,000 megawatts of aging gas-fired utility facilities statewide could be replaced or modernized. High-efficiency aeroderivative gas turbine power plants can produce more electricity while

CALIFORNIA ELECTRIC GENERATION SYSTEM EFFICIENCY (TRILLIONS OF BTU'S)



Source: California Energy Commission.

using less fuel and producing less pollution than the aging power plants.

Despite the great attractiveness of the highly efficient new power plant technologies, building large numbers of new gas-fired power plants with 30-year lifetimes would raise legitimate questions about the possible energy and environmental consequences of committing electric utilities to long-term gas dependency. The California Energy Commission's *1990 Electricity Report* will closely analyze the issue of electricity system vulnerability given the uncertainties about future gas prices and supply availability.

The Role of Economic Incentives

In many cases, economic incentives provide a more efficient and effective means than traditional regulatory approaches for dealing with utility regulation and with pollution. The traditional regulatory approach relies on setting and enforcing uniform rules or standards. With this approach regulatory agencies usually find it necessary to spell out in detail exactly what is to be done under all foreseeable circumstances, specifying acceptable procedures and

equipment. Traditional regulation is the "command-and-control" approach.

In contrast, economic incentives seek to make the self-interest of individuals coincide with public interest. Government entities establish public objectives, such as measures of utility performance or environmental quality, and allow people to find the best way to meet those objectives. It is critical to understand that moving from traditional regulations to economic incentives is a change in regulatory approach, not an abdication of regulatory authority. Government bodies would still set public objectives, monitor that the objectives are achieved, and revise the incentives as needed to assure the desired results.

The use of economic incentives has several advantages over the traditional regulatory approach. A well designed economic incentive system gives affected people both the incentive and the flexibility to choose the lowest cost methods to achieve the desired public objective. Economic incentives harness individuals' ingenuity to achieve the public objective, thus promoting innovation. Under the traditional regulatory approach, this ingenuity tends to be focused on avoiding control, thus frustrating the public objective. By stimulating willing cooperation, economic incentives can considerably reduce enforcement burdens on regulators.

Economic incentives are a useful technique for dealing with environmental "externalities" (costs that are not borne by the people who cause them), such as pollution, traffic congestion or other environmental ills. Creation of appropriate economic incentives can bring these environmental costs into the market ("internalize" them), where economic forces can influence these costs. Techniques to do this include pollution taxes, tradeable pollution permits and highway user fees. Chapter 6 discusses economic incentives for emissions control.