

REPORT TITLE: 1) Comparative Analysis of Energy Alternatives.  
2) Comparative Environmental Analysis of Energy Alternatives to OCS Oil and Gas,

STUDY TITLE: Comparative Analysis of Energy Alternatives to OCS 011 and Gas.

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**KEY WORDS:** Energy Alternative<sup>s</sup>, Least-cost Planning; Lie-cycle Costs; Environmental impacts; Imported Oil; Conservation; Renewables; Fuel Substitution; OCS Oil; OCS Gas; Methanol; Compressed Natural Gas; Gasohol; Diesel; Fuel Economy Nuclear; Coal; Wind; Solar Thermal; Photovoltaic.

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**BACKGROUND:** In the past Five-Year Programs the Minerals Management Service (MMS) maintained that imported oil was the most likely economic alternative to outer continental shelf (OCS) oil and natural gas. In response to a request for comments on its plan to develop the Comprehensive Program, MMS received the following suggestions 1) Imported oil is not the only alternative to OCS oil and natural gas from an economic standpoint, 2) government-imposed conservation is the best alternative to OCS oil and natural gas, and 3) government-managed least cost planning rather than the free market is the preferred method for the nation to make energy use decisions.

As a component of its ongoing update of information and analysis concerning energy alternatives, and in consideration of these public comments, MMS is reassessing: 1) the approach it uses to evaluate energy alternatives, 2) the accuracy of assuming barrel-for-barrel replacement of OCS oil and natural gas with imported oil under market conditions, and 3) the adequacy of its consideration of conservation and other energy alternatives.

**OBJECTIVES:** (1) To identify and to examine the viability and desirability of energy alternatives to the proposed leasing in the Comprehensive Outer Continental Shelf Oil and Natural Gas Resource Management Program (Comprehensive Program); (2) To identify environmental impacts associated with these energy alternatives for the Environmental Impact Statement (EIS) on the Comprehensive Program; and (3) To respond to public comments submitted to MMS relating to the selection of the energy alternatives and planning methodology included in the Comprehensive Program.

**DESCRIPTION:** Statistical and other estimates of oil and gas market supply and demand responses to changes in price were used to determine the likely overall changes in U.S. oil and gas supply and demand if OCS oil and gas production were reduced over the 2000 to 2020 period. Subsequently, ICF Resources identified and evaluated the economics of specific energy alternatives for in-depth analysis

was to look for commercial or near-commercial alternatives to use of oil and gas in major applications. ICF used Me-cycle cost analysis to determine whether government imposition of the identified energy alternatives would likely yield net cost or savings to the nation as a replacement for OCS oil and gas over the 2000-2020 time period. Full Me-cycle costs were developed for each alternative as well as for a base case. For each alternative, assumptions of discount rates, energy prices and end-use characteristics were kept consistent to allow for comparison of total economic costs between different alternatives.

The environmental impacts of alternatives to OCS oil and gas were considered separately from the economic cost. Just as with economic costs, environmental impacts for each alternative were identified for each stage of the fuel cycle. Impacts were placed into four categories and 15 subcategories: Air Impacts - ambient pollution, stratospheric ozone, acid rain, global warming, and noise; Water Impacts - surface water pollution, groundwater contamination, and ocean pollution; Land Impacts - soil contamination, loss of wetlands, habitat disruption, and soil erosion, and Societal Impacts - scenic pollution, health and safety, and change in land use. A set of matrices was developed which summarized the different impacts by category for each stage of the fuel cycle of each alternative considered.

The results of ICF Resources' analysis are detailed in the report dated February 1991. A reference report was also provided summarizing the results with a focus on the environmental impacts associated with supplying each energy alternative.

**SIGNIFICANT CONCLUSIONS:** The assumption that reduced OCS production of oil and gas will be replaced on a barrel-for-barrel basis with imported oil is essentially correct for OCS oil, but OCS gas is likely to be replaced by increased onshore production as well as increased oil imports, gas imports, and conservation. Furthermore, potential government actions to force energy alternatives to OCS oil and gas would, in general, cost the nation more than relying on the "no action" market energy alternative to reduced OCS oil and gas production. There is still some potential for further cost effective oil and gas conservation, but this potential is now quite low.

The types of environmental impacts of the oil alternatives are the same as for OCS oil. All of the alternatives have substantial impacts on air, even oil conservation. However there is some variation in the impacts on water, land, and society; and in these areas the oil conservation alternative appears most beneficial,

The environmental impacts of the gas alternatives can be expected to be the same in some of the categories as OCS gas. Some of the patterns, however, are very different. Gas conservation is clearly more environmentally attractive than any of the other alternatives. Renewable energy alternatives and nuclear power are most beneficial in terms of air impacts; and renewable are most beneficial in terms of impacts on water, land, and society.

**STUDY RESULTS:** ICF estimates that 56 percent of a barrel of OCS oil production in the long-run would be replaced by oil imports. Ten percent of the total OCS oil production would be offset by a decline in consumption and four percent would be offset by increased U.S. oil production. The decline in consumption is expected to be achieved primarily by conservation, but about 40 percent (or 4 percent of the OCS oil total) would be substitution of gas for oil. ICF also estimates that only 54 percent of the reduced OCS gas production would be replaced by oil on a BTU basis. Most of this oil would be imported residual fuel. The analysis indicates that 44 percent of forgone OCS natural gas production would be offset by increased natural gas imports. The remaining 14 percent of lost OCS gas production was estimated to be offset with conservation.

The results of the economic analysis of energy alternatives indicate that potential government actions to force energy alternatives of OCS oil and gas would in general, cost the nation more than relying on the

“no action” market energy alternative to reduced OCS oil end use production. The net cost to society of displacing a gallon of OCS oil production by means of the various alternatives considered are as follows: methanol-powered vehicles (11.47 cents/gal.) compressed natural gas powered vehicles (23.4 cents/gal.), gasoline-powered vehicles (149.7 cents/gal.) and diesel-powered vehicles (6.1 cents/gal.). Small increases in fuel economy was the only oil alternative with a net savings, estimated at 40 cents/gal. displaced.

The net cost to society of displacing a thousand cubic feet (Mcf) of gas by means of alternatives to natural gas in electricity generation were estimated to be as follows: base-load nuclear (69.59 cent/Mcf), intermediate-load coal (117 cents/Mcf), oil-fired steam (44.22 cent/Mcf), intermittent-load wind (1.47 cents/Mcf), intermittent-load photovoltaic (51.05 cents/Mcf), and intermittent-load solar thermal (1.55 cent/Mcf). The only electric power alternative with a net savings was base-load coal with a savings of 7.42 cents per Mcf displaced. Two conservation options had net savings: increased residential building shell efficiency in gas-heated homes (1.55 \$/MM BTU gas displaced), and increased residential gas appliance efficiency (3.72 \$/MMBTU gas displaced).

The environmental analysis consisted of identifying in detail all of the impacts of each alternative. These impacts are provided for the complete fuel cycle of each alternative in the main report and for the production and transportation components of the fuel cycle in the shorter reference report.

STUDY PRODUCT(S): 1) ICF Resources Incorporated. *Comparative Analysis of Energy Alternatives*. Prepared for the Minerals Management Service of the U.S. Department of the Interior. February 1991. 2) ICF Resources Incorporated. *Comparative Environmental Analysis of Energy Alternatives to OCS Oil and Gas*. March 1991.

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