Appropriate Combinations of Technology Landscape Management for Solving Problems— Session L: Outer Continental Shelf and Coastal Energy Development

Managing the Visual Effects of Outer Continental Shelf and Other Petroleum-Related Coastal Development[1]

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Abstract: Five petroleum-related facilities often sited in the coastal zone during development of Outer Continental oil and gas can change the visual appearance of coastal areas. These facilities are service bases, platform fabrication yards, marine terminals and associated storage facilities, oil and gas processing facilities, and liquified natural gas terminals. Examples of innovative approaches to managing the visual impacts of these facilities are discussed. Subject areas requiring additional research are identified.

INTRODUCTION

In this paper we discuss issues related to the visual impact of Outer Continental Shelf (OCS) and other petroleum-related coastal development: 1) The OCS oil and gas development cycle; 2) the visual effects of service bases, platform fabrication yards, marine terminals and associated oil storage facilities, oil and gas processing facilities, and liquefied natural gas (LNG) terminals; 3) innovative visual management strategies designed to mitigate the impacts of these facilities; and 4) subject areas requiring further consideration by the planning and research community.

Why should OCS or other petroleum-related coastal energy development be of concern to visual planners?

First of all, the leasing of offshore tracts on the federally owned OCS through 1985 is planned for areas of New England, the Mid-Atlantic, South Atlantic, Gulf of Mexico, Pacific, and Alaska. The amount of imported oil has increased tremendously since 1973. Right now we import about 50% of our oil. Imported oil must be brought ashore, usually through a tanker terminal and associated storage facilities. In addition, there are a number of proposals to import liquefied natural gas, which will also require terminals on the coast to receive and regassify the liquefied natural gas (LNG).

Most of the visual impacts of OCS development will be from the onshore oil and gas related facilities rather than from the offshore platforms. Because most lease areas are far out at sea, in most coastal areas the offshore platforms will not be visible from the shore. The exceptions to this occur in the Gulf of Mexico, Southern California and the upper Cook Inlet of Alaska.

Petroleum-related coastal development is a large scale industrial activity. The facilities directly required to support OCS or other oil and gas development, such as platform fabrication yards, or processing facilities are massive and are of an appearance which may restrict our options to mitigate their visual impacts.

Another consideration concerning the visual impacts of these facilities is that offshore technology, and the onshore facilities supporting offshore operations, is a foreign technology to most regions of the country, with the exception of parts of Texas, Louisiana, Southern California and Alaska.

[1]/ Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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as in the case of the VIEWIT computer visibility model. This type of approach can deal more effectively with the problem of simulating a great many different viewpoints within a complex landscape, to determine what would in fact be visible from each viewpoint (Amidon and Elsner 1968). In general, many of the techniques are concerned with producing a map of classified impact areas, including such factors as number of persons perceiving the scene, the duration of time involved, the distance from the viewpoint to object, and the percentage of the viewscape dominated by the facility.

A composite approach derived from these sources can be described as follows:

--Visual characteristics of each landscape unit are determined, and changes of these characteristics with the proposed facility are described. Landscape units include landforms and land cover patterns. A rating can be assigned to measure extent of change. Visually fragile areas would have a high damage rating.

--Areas of increased viewer sensitivity are identified, often by using surveys of residents to determine preferences. Special attention is given to viewpoints defined by major roads or other high-exposure points or lines. The intensity of use of these points determines the number of people exposed to the facility site.

--Potential mitigation techniques, such as screening, faculty design, and micro-scale siting approaches are considered. See the next section for a detailed example.

--Future land uses are mapped for compatibility of visual impact.

--Overlay maps are combined to produce a final suitability map. Individual maps can contain constraint ratings to be combined to determine areas of highest to lowest compatibility. These ratings can be constructed by selecting viewpoints from which to determine "before" and "after" visual effects. Effects can be simulated by photographs, drawings of proposed facilities, or by computer. Subjective evaluation by a panel or experts can be used also.

--In the case where evaluator's responses are used, a visual quality (VQ) rating for a given viewscape has been suggested as a simple average of intactness, vividness, and unity. Intactness is defined as the apparent degree of natural condition as a function of human encroachment; vividness is influenced by sharpness of boundaries, amount of topographic relief, and contrast in visual elements; unity is a measure of visual harmony or balance influenced by similarity of form, line, color, and texture.

CHARACTERISTICS, VISUAL EFFECTS AND IMPACT MANAGEMENT OF PETROLEUM-RELATED COASTAL DEVELOPMENT

Service Bases

The service base (fig. 1) is the staging area

Figure 1--A service base which supports OCS development in the North Sea.

established by an oil company or independent service contractor for shipping equipment, supplies, and personnel to offshore sites during OCS development. The base may include berthage space for 180- to 220-foot supply and crew boats, dock space for loading and unloading supplies, warehousing, open storage areas, buildings to house supervisory and communications personnel, and a heli-pad. The size of the base and level of vessel activity depends on the number and kinds of exploratory vessels and drilling rigs being served, but are usually between 25-50 acres. Service bases operate 24 hours a day on military - like schedules, and must be illuminated during the night. (New England River Basins Commission 1976). As mentioned earlier, service bases are a port-related facility, and have the same general berthage and repair requirements as ocean going fishing vessels. In fact, in Scotland some of the bitterest controversies were over who had the rights to the wharves in Aberdeen and Peterhead, the oil men who could pay high leases or the traditional users, the fisherman. It was only resolved when new piers were built for the service bases (Baldwin and Baldwin 1975).

Since a key locational criterion for service bases is distance to the offshore tracts, there isn't always a perfect port location available, particularly in remote or sparsely populated areas. The service base at Norscot, in the Shetlands had to be constructed from scratch, and is a foreign element to the island. An area like the Shetlands presents difficult visual design problems. It is an

OCS OIL AND GAS DEVELOPMENT CYCLE AND ASSOCIATED FACILITIES

Onshore facilities and impacts are triggered by offshore development activities, and are directly related to offshore activities.

OCS development occurs in three stages following the leasing of offshore tracts; exploration, development and production. There is considerable overlap between stages.

The New England River Basins Commission identified 10 facility types that are likely to have significant visual impact (NERBC, 1976). These facility types are:

1. Service Bases
2. Pipelines
3. Marine Terminals
4. Gas Processing Plants
5. Petrochemical Plants
6. Repair and Maintenance Yards
7. Partial Processing Plants
8. Refineries
9. Platform Fabrication Yards
10. Pipe Coating Yards

There are specific onshore facilities related to each stage of offshore development. Service and support facilities (1, 6) are established soon after leasing and continue functioning through the development cycle. Platform fabrication yards (9) are established only after sufficient oil and gas have been discovered to justify a platform construction facility. Transportation and processing facilities (2, 3, 4, 5, 7, 8, 10) are constructed during the development stage of OCS oil and gas resources and come into operation during the production stage. The duration of the OCS development cycle can be surprisingly long--as much as 30 years.

OCS development isn't instantaneous, so there is some time to plan for facilities. Once oil and gas are discovered the pace of activity can accelerate tremendously. Onshore activities and facilities will begin appearing long before the first drop of oil comes ashore.

We can categorize onshore OCS-related facilities in a number of different ways besides the stage of development in which they are required. Certain onshore OCS-related facilities are port related, while others are not. Service bases are a port-related facility. If possible, industry would prefer to locate a service base in an already existing port area. Platform fabrication yards are not port related but are still coastal dependent. They require direct water access. Other facilities, particularly processing facilities like oil refineries or gas treatment plants don't require water access.

VISUAL IMPACT ASSESSMENT FACTORS

In general, important characteristics of facilities and viewers include:

1) The location of the project, e.g., in a rural or urban setting. In a rural setting, micro-level landscape characteristics can be important. In an urban commercial setting, nearby land uses may be compatible because of pre-existing port facilities or related energy establishments. In extreme cases, virtual "energy parks" are already in existence that consist of a complex of energy and transportation facilities, for example in parts of New Jersey.

2) The physical size of the facility relative to its surroundings. The areal extent of the facility.

3) Duration of exposure to visual impact. Construction, operation, and maintenance often involve very different procedures and lead to great variation in visual impact over time. As community development occurs, at least some facilities will exhibit a transient rather than permanent nature. In one study done on the cumulative impacts of onshore oil and gas facilities, the major land use impact peaked within 10 years and was at only about one-half the peak level twenty years after initiation (Smith 1978). This can mean decommissioning and removal of the objects causing visual impact; it can also mean deterioration, neglect, and very poor visual quality after a period of years.

4) The expectations of the viewers. A single large facility in a rural community presents a much sharper contrast than a facility clustered with other similar land uses. It is likely that the visual expectations of the viewers in a community totally devoted to energy development is different from those expectations of viewers from other communities. Viewer expectation affects perceived visual impacts. Morgan City, Louisiana bills itself as the "offshore capital of the world." People live there, on the average, for about 4 years, and they may have minimal expectations about the quality of the visual environment during their stay. Morgan City is not devoid of visual amenities, as there are parks and open space. But there are no visual criteria applied to the industrial facilities, which dominate the central community district.

Utilizing the existing environment as a baseline from which to measure change, a vital step is to provide some measure of the impact of a proposed oil and gas facility. A number of approaches are available for this purpose, sometimes originally developed for evaluation of other types of artificial structures imposed on the landscape (Vaugh 1974, and Battelle 1974). The method used can utilize advanced computer technology, area of basically low relief, vegetated with grasses and shrubs but not trees. It is very difficult to integrate an industrial facility into this environment.

Platform Construction Yards

"Steel platform fabrication yards (fig. 2)

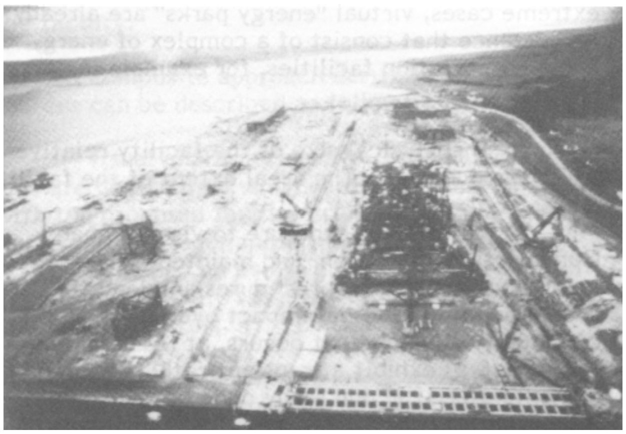

Figure 2--Platform fabrication yard.

are large, water-front facilities, consisting mostly of cleared land, buildings, shops, and administrative offices set back from the waterfront. The steel platforms are constructed close to the waterfront at marginal wharfs. Industrial infrastructure--roads, railroads, power lines, etc.--is evident.

"The layout, requirements and impacts of the fabrication yard are determined, in large part, by the number and complexity of platforms being constructed. The size of the yard depends upon the size and number of platforms constructed annually, as well as the number of platform components fabricated on the site.

"A platform yard does not have to be sited in the lease region; one yard can service several adjacent lease areas. Platforms are commonly constructed far from the lease area and towed long distances to the site. If a fabricator does choose to build a new facility in a frontier area it will be established only after a significant find has been made, its size has been determined, and the development schedule has been set," (New England River Basins Commission 1977).

Factors affecting the location of platform construction yards include the cost of transporting platforms to the OCS, the availability of skilled labor, and a mild climate, if possible, which favors year round operations. Platform fabrication yards require a large, level site of from 200-1000 acres. This is too much land to be economic in an already developed port area, so these yards will often be located in rural coastal communities.

Platform fabrication yards are very visible, and present great difficulties in mitigating their visual effect.

Concrete platform fabrication yards differ from steel platform fabrication yards in that deeper water is required adjacent to the site: about 35-50 ft. at the pier, and 150-300 ft. within several hundred yards. The 30-80 ft. bases are constructed in a dry dock and then floated a few hundred yards at most to very deep (150-300 feet) water for construction of the tall pillars upon which the deck section is attached. Thus the single most important requirement is a large open site with immediately adjacent very deep water (New England River Basins Commission 1977). The requirement for adjacent deep water presents a potential conflict between concrete platform fabrication yards and other uses. In the North Sea, fjord-like sites were selected both in Scotland and Norway for these facilities. In Scotland this caused bitter conflicts. In Norway, the government arranged a form of compensation for the impacts of the yard at Stavanger. The developer agreed to construct a pleasure boat marina in exchange for approval to locate the platform fabrication yard. At present it is unlikely that concrete platform fabrication yards would be required in the U.S., with the only remote possibility being in Alaska if large amounts of oil and gas are discovered in areas with severe weather conditions.

Oil Terminals and Storage Facilities

Oil produced from the OCS will be transported to shore through undersea pipelines, tankers or barges. The determination of a transportation strategy includes such factors as location and amount of oil to be transported, location of processing facilities, and nature of undersea topography, among others. Imported oil will be transported to the U.S. via tankers.

Marine terminals may serve several functions, according to a report by the New England River Basins Commission (1976):

- load crude oil received by pipeline from offshore production platforms onto tankers for final delivery to refineries;
- receive crude oil from tankers for delivery by overland pipeline to nearby refineries;
- receive crude oil from supertankers and very large crude carriers for delivery to nearby refineries; and

• receive refined petroleum products from tankers and store them for delivery overland to final markets."

Oil terminals which would receive either OCS derived oil or imported oil have two basic components: 1) a port facility to receive or transship oil and; 2) large storage tanks which hold the oil until it can be shipped. Factors affecting the location of a marine terminal include the location of the pipeline landfall, if any, the location of refineries and the presence of deep water (50-60 ft.) close to shore.

The ordinary design of oil terminals is determined by economic and engineering constraints. The marine terminal is water dependent, and although the storage tanks need not be, they are often located at the coast. Both tankers and storage tanks are very prominent objects, which are often visible for some distance. The storage tanks can be as high as 150 ft., and fully capable of dominating coastal horizons.

There have been a number of attempts to ameliorate the visual impacts of oil storage facilities. The Baldwins (1975) describe an effort by British Petroleum (BP) to locate their storage facilities associated with a tanker terminal in the Firth of Forth:

> Local authorities encouraged BP to avoid placing unsightly oil storage tanks along the banks of the scenic Firth of Forth. Instead, BP created a tank farm three miles inland at Dalmeny, in the midst of a huge hollowed out mountain of oil shale tailings which has been carefully landscaped to screen the tanks from public view.

Milfordhaven is a large oil port on the coast of Wales. There are numerous oil storage facilities present, many of which are quite prominent. However, there have been attempts to hide or at least diminish the visual impacts of these facilities. One technique masks the full height of the tanks by placing them in a recessed area and surrounding them with an earthen berm. This has the effect of placing them below the horizon and exposing only a fraction of the tanks to view.

Oil and Gas Processing Facilities

Oil and gas must be processed before commercial use can occur. In general gas processing facilities do not require large amounts of land, usually about 50-75 acres, of which only 20 acres is actually built upon (fig. 3). As documented by the New England River Basins Commission (1977),"Similar in appearance to a refinery though smaller, a gas processing and treatment plant is designed to strip impurities and valuable liq-

Figure 3--Natural gas processing plant.

uefiable hydrocarbons, such as ethane, butane, and propane, from the raw gas stream before it enters the commercial gas transmission line. There are no standard sizes or designs for gas plants; a plant is specifically designed for the gas stream it processes and may range in throughput capacity from two million cubic feet per day to two billion cubic feet per day. Gas plants generally have a life of from 10-20 years, depending upon the availability of the natural gas supply."

Facility siting considerations for gas processing plants include the size and quality of the gas discovered, the location of the pipeline landfall and the commercial gas transmission lines (as the plant must lie between the two) and, whether the plant will provide feedstock for the petrochemical industry.

A gas plant often has tall vertical stacks and pipework which can contrast sharply with the surroundings. Because of safety considerations gas plants are often sited in rural areas.

The St. Fergis gas terminal in Scotland has an appearance strikingly different from that of more traditional gas processing facilities (fig. 4). The final visual design of the plant was developed

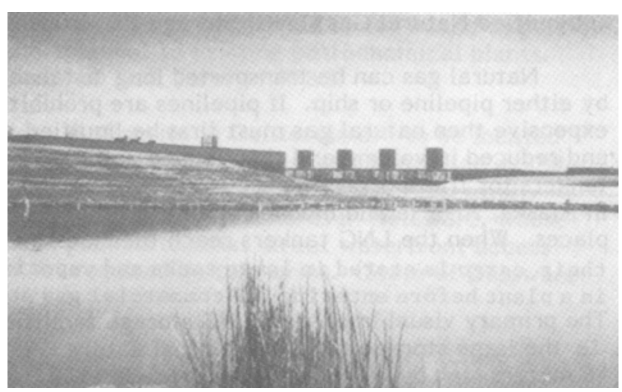

Figure 4--St. Fergis gas terminal, Scotland.

collaboratively by the energy company and the local planning authority. Much of the tall pipework has been hidden, some of it in lower black utility structures, which greatly reduces the vertical dimension of the plant. In addition, at the request of the planning authority, the company agreed to design a circular fire pond with some provision for wildlife habitat, rather than the standard rectangular design.

"The modern refinery is a series of processing units designed to produce a number of petroleum products by physically or chemically altering all or part of the crude oil stream. How complex the refinery is depends upon the type of crude oil being refined and the number and kinds of products desired. Complexity generally increases as the percentage of gasoline and other 'light' products produced increases. A typical refinery will include processing units, storage tanks, water treatment facilities, offices, machine shop, storage and warehouses, electrical substation, firehouse, pumping station, truck loading areas, pipelines, rail spur, parking areas, and a buffer zone. Refinery sites are often large (1000-1500 acres for a 250,000 bbl/ day) but with only a small percentage of total area in intensive use.°(New England River Basins Commission 1977).

There is no direct correlation between oil production on the OCS and development of new refinery capacity. It is expected that OCS oil will substitute for imported oil for use in refineries. The basic refinery siting considerations include the existence of a market for refined products, the assurance of a long-term supply of crude oil to assure that plant capacity factors can be met, the availability of land and water and the ability of the plant to meet air and water quality regulations.

Refineries, due to their size and significant contrast with any but industrial uses, present substantial challenges to visual impact mitigation. A possible means of managing the visual impact attempted at Milfordhaven was to screen all but several stacks from view behind a large berm.

Liquified Natural Gas (LNG) Storage Facilities

Natural gas can be transported long distances by either pipeline or ship. If pipelines are prohibitively expensive then natural gas must first be liquefied and reduced in volume and then loaded onto tankers for transport. This is currently occurring in Alaska, Algeria and Indonesia, among other places. When the LNG tankers reach their destination their cargo is stored in large tanks and vaporized in a plant before entering the commercial gas stream. The primary visual impact of LNG storage facilities is the large storage tanks, of approximately 46 meters high by 46 meters diameter. In 1972 the Boston Gas Company converted an LNG storage area in Dorchester from a grimy industrial site characterized by gray oil and gas storage tanks and outbuildings to a modern-looking LNG terminal and associated park and fishing areas. (fig. 5). Boston Gas had new tanks installed, and commissioned artist Corita Kent to develop

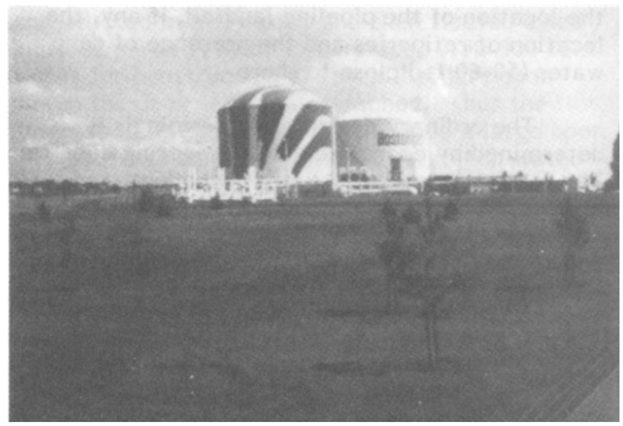

Figure 5--Liquified Natural Gas (LNG) Terminal, Boston Gas Company.

a bold graphic for the facility. She designed a rainbow motif of deep blues, purples and greens for one tank and highlighted the otherwise white colored pipework with deep bold colors. The community reaction to the renovation has been quite positive and the facility is considered a neighborhood landmark.

INSTITUTIONAL CONSIDERATIONS

Many of the examples of good visual impact mitigation of OCS or other coastal-related petroleum development have occurred in Scotland in relation to North Sea energy development. The British concern for visual quality is reflected in their planning system which in turn has affected the location and design of these facilities.

Under the Town and Country Planning Act of 1947, localities in the UK zone their lands for development within their jurisdiction. The local or regional plans are subject to approval at the national level. Any proposed development which departs from these plans, such as OCS related development did, must be referred to the Secretary of State for his consent. The Secretary of State is an elected member of Parliament nominated to this cabinet position by the Prime Minister.

Because of this institutional situation, a number of OCS-related onshore facilities received national scrutiny during the siting process. This particularly affected the siting of a concrete platform fabrication yard proposed for the town of Drumbuie in 1973-74. Drumbuie was a hamlet of only 24 people on the west coast of Scotland. The land for the site, moreover, was leased by farmers from the National Trust, a private organization devoted to the preservation of particularly scenic lands. The matter was resolved when the Secretary of State denied a permit for the facility, largely on aesthetic grounds. Approval for the facility instead was given to a site at Kishorn, which was, if anything else, an even more visually attractive location (Baldwin and Baldwin 1975). The visual appearance of OCS-related onshore facilities is an important concern at the local level also. Permitting usually occurs in two steps, both of which involve the collaboration of industry and the local planning authority.

Industry applies for initial "outline planning consent" early in the siting process. Dean and Graham (n.d.) describe the outline planning process as follows;

"During the preliminary stage of site selection, the full-time officers of the local planning authority will be consulted on an informal basis and their views will be taken into consideration. When a specific site has been selected, an application for outline planning consent is submitted, i.e., the planning authority is being asked to approve in principle the development of the site for the required purpose requested, thus allowing the expensive and lengthy planning and design work to proceed with the knowledge that the plant can in fact be constructed, subject to subsequent approval of detail. This outline consent stage is probably the most difficult of all and can be very lengthy-many months or even years."

During the negotiations concerning the granting of outline approval visual considerations become a key factor. After these consultations have been completed the elected members of the Local Planning Committee consider the application. If approval is denied, then the applicant has the right of appeal to the Secretary of State.

If outline approval is granted a second stage of detailed planning consents is initiated. At this point the site plan is extensively reviewed, particularly for actions or structures which may create a visual impact (Dean and Graham n.d.).

The planning framework in the U.S. for OCS and other petroleum related coastal development has been quite different from the British model. Traditionally the authority over the visual appearance of industrial facilities has been solely a local responsibility. Many local governments, in their attempts to lure economic growth, have been reluctant to apply stringent visual controls which would affect the appearance of industrial facilities. Unless state or local lands were affected by these facilities, there was no intervention from those governmental levels into the visual appearance of the facilities.

But now, through the coastal zone management process currently being established, many states are recognizing the importance of the visual resource. Many states are identifying critical visual resources upon which development would be prohibited, and several states are managing industrial development on the coast with an eye for reducing their visual impacts.

The California Coastal Plan has policies to locate industrial facilities away from scenic areas identified in the coastal plan. It also specifically states that in no event is a new refinery to be placed in a highly scenic area. (State of California 1976.)

The Maryland CZM plan states that state approval of an OCS facility will be denied if siting would cause a significant adverse impact on scenic or natural beauty. This also includes development on sites adjacent to scenic areas. (State of Maryland 1978.)

In addition, a number of states which don't have explicit sections on visual quality do have policies on OCS related facilities in the coastal zone. These policies have an effect on where OCS facilities can locate and therefore, on their visual impacts.

One set of policies, followed by states such as California, Maryland, New Jersey and Delaware, is to locate OCS related facilities in already developed industrial areas or in specific areas where oil-related development presently exists.

Another set of policies serves to discourage certain facilities from locating in the coastal zone at all. The New Jersey plan calls for gas processing plants to be excluded from the coastal zone and to be located as far inland as possible, and adjacent to existing petrochemical plants. (State of New Jersey 1978.)

Refineries in California are to be located at reasonable inland sites, and to provide a buffer zone to minimize impacts. This is essentially the same policy which holds in Delaware, whose CZM plan states that direct waterfront access is not required by refineries. (State of Delaware 1979.)

Finally, one policy may be to exclude a facility from anywhere in the State. Delaware did this for LNG terminals for safety reasons.

The visual impact of the facility probably did not play a major role in this decision.

RESEARCH ISSUES

A number of issues concerning how best to manage the visual effects of OCS and other petroleum-related coastal development require further attention by the research and planning community.

1. Studies are required to compare the relative effectiveness of visual planning as opposed to visual impact mitigation. Visual planning seeks to avoid scenically incompatible locations for these facilities. Visual impact mitigation seeks to establish the best design possible for already selected sites. Few studies have been performed in the U.S. or in the UK which have explicitly factored visual criteria into broad regional siting studies. A comparative analysis of the utility of planning vs. mitigation could help planners and designers determine the most appropriate points in the planning process to insert considerations of visual quality and impact.

2. Tests should be conducted, preferably by using simulations or field techniques, to assess the effectiveness of various visual impact mitigation methods. For a given facility, a number of alternative designs may be developed which purport to minimize its visual impact. More information is required to know how these alternative strategies operate in different settings or with different viewers.

3. Compensation should be examined as a form of impact assistance to be provided by industry to adversely affected states or localities. Payments by industry to compensate or assist communities subject to rapid growth associated with energy development projects are being used at present to provide needed roads, water supply, community centers and required commercial development, among other provisions. States and localities should and often do negotiate with energy developers for the terms of impact assistance. The provision of funds to purchase title or scenic easements on offsite lands may be used as compensation for onsite visual impacts which cannot be mitigated. This method can help to internalize the external diseconomies of siting decisions, that is, to represent more realistically the real costs of such decisions and to feed them back into the decisionmaking process.

ACKNOWLEDGEMENTS

The authors wish to thank the following individuals and organizations for making their photographs available and providing their perspective on the visual impacts of petroleum-related coastal developments; Keith Hay, American Petroleum Institute; O.J. Shirley, Shell Oil Company; The Boston Gas Corporation; Maire Murphy, New England River Basins Commission; Barry Lawson, Lawson Associates; David Williams, Management Consultant; Jack Farlow, U.S. Environmental Protection Agency; and Bob Matthews and Brandon Wilson of the U.S. Geological Survey. Photo credits are as follows: Fig. 1, New England River Basins Commission; Fig. 2, Keith Hay, American Petroleum Institute; Fig. 3, O.J. Shirley, Shell Oil Company; Fig. 4, Total Oil Company, UK; Fig. 5, Boston Gas Company.

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