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Final Report

Policies to Affect the Pace of Leasing And Revenues in the Gulf of Mexico Summary Report

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Part 1. Summary Report

by

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Part I. Summary Report

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Executive Summary

This study examines alternative leasing policies for Outer Continental Shelf (OCS) oil and gas resources in the Central and Western Gulf of Mexico (GOM). For each potential policy, we estimate the resulting levels on exploration, production, revenues and other impacts associated with OCS development. We also explore whether Areawide leasing for the OCS reduces the returns to leasing in the waters of coastal states, using Louisiana as an example.

Since 1983, offshore leasing has used an Areawide leasing policy, whereby nearly all blocks available for leasing in a region are offered for sale. The Areawide approach has been controversial, with some arguing that it has reduced competition and leasing revenues. Others have countered that Areawide leasing may not reduce overall revenues when one also considers the effects on royalties, area rentals, and federal corporate taxes.

An analysis of alternative leasing policies is well justified, given the significance of OCS oil and gas resources, dramatic changes in offshore technology, highly volatile oil prices, increasing national security concerns for added domestic sources of energy, and the potential for an increased role of coastal states in the leasing program under various ongoing Congressional Initiatives.

Organization of the Study

Our assessment focuses on tracts to be leased on the Central and Western Gulf of Mexico planning areas over the 50-year period from 2010 – 2060. The study is organized into three integrated tasks:

- Task 1 identifies alternative leasing systems, and outlines a set of Goals and Criteria for assessing alternative leasing systems
- Task 2 develops the modeling approach that quantifies the Criteria developed in Task 1, and
- Task 3 uses the output of Task 2 to assess each leasing policy alternative relative to the current Areawide leasing approach.

Some fifty potential leasing alternatives are identified, and then are reduced to a manageable "short list" of 12 policy alternatives for detailed analysis. The policies examined include two options for slowing the pace of leasing, three options for changing royalty rates, higher minimum bids, two options for profit shares, an increase in area rental payments, use of a multi-round bidding system, implementation of work commitments, and a reduction in the length of the primary lease period.

Novel aspects of the study are the use of a resource inventory approach, incorporation of OCS oil and gas technological advances, use of a probabilistic approach for forecasting the size of new discoveries, use of an economic experiment to assess multi-round bidding in OCS auctions, and the integration of all these study elements into a single, comprehensive framework.

Key Study Results and Conclusions

Despite the many uncertainties involved, the empirical results provide many useful insights into potential effects of the various policy alternatives. First and foremost, the results show that there are important tradeoffs across policy alternatives, so no single policy is best at achieving all Goals. Nor does any individual policy dominate the status quo policy. Rather, some policy alternatives perform better than the status quo in terms of some Goals, but not as well in terms of other Goals. So choice among policies depends upon value judgments regarding the relative importance of the various goals.

Our study also finds that comparisons across lease alternatives are complex, because there are multiple offsetting effects. In many cases the overall effect of a policy is greatly mitigated by these offsetting effects, so that differences across policies are often smaller that one might predict. Below we discuss each category of lease sale alternative, and highlight some of these effects.

Our Study finds that a *slower pace of leasing* significantly increases bidding revenues, but this increase is offset, in whole or in part, by reductions in the discounted value of royalty payments, area rentals and federal taxes. Although it is possible that overall Federal revenues may increase somewhat with a slower pace of leasing, large increases in revenues cannot be expected. At the same time, a slower pace of leasing adversely affects expeditious development of OCS resources and overall social value of OCS resources, while increasing the competition for tracts and reducing environmental risks of OCS development.

Our results show that use of a *higher royalty rate* can increase royalty payments, but these gains are offset by associated reductions in cash bonus bids, area rental fees, and federal corporate taxes. Higher royalty rates also adversely affect expeditious development of OCS resources, reduce competition for tracts, and reduce the overall social value of OCS resources. At the same time, higher royalties reduce regional planning costs and environmental risks. Coastal states may benefit from increased royalty rates through future revenue sharing under GOMESA, but these gains are offset by reduced onshore expenditures associated with lower levels of offshore activities.

Higher minimum bids are shown to increase cash bonus bids on some low-valued tracts, but also result in a reduction in the number of tracts sold. The tracts that go unsold will disproportionately be marginal tracts that would typically receive only a single bid, so that the average bid per tract sold is expected to increase. Increasing the minimum bid reduces OCS activities, thereby facilitating regional planning and reducing potential environmental risks, but adversely affecting the economies of coastal states by reducing onshore expenditures associated with offshore activity.

Our study finds that *profit shares* may increase government take through this source of revenue, but at the same time profit shares reduce the value of tracts to firms, and therefore reduce cash bonus bids, federal corporate tax payments and the number of tracts sold. Overall, we find a small decrease in OCS revenues when adding a profit share to the status quo policy, and a larger decrease in revenue when using profit share in lieu of royalties. More importantly, profit share may adversely affect the integrity of the leasing process because of the important practical

problems attempting to validate profits reported by firms. Indeed, past experience has found considerable difficulties in reaching agreement on the proper profit share payments.

Increasing the area rental rate reduces the number of tracts sold, thereby reducing expeditious development of OCS resources. Higher area rental payments can be expected to be offset, in whole or in part, by decreases in cash bonus bids, royalty payments and federal taxes. Increased area rental payments increase the average number of bids per tract sold by reducing sales of marginal tracts that would otherwise typically be sold with only one bid.

Multi-Round Auctions result in more tracts sold, but otherwise adversely affect most Criteria for development of OCS resources, revenues and overall social value. This occurs because multi-round auctions lead to more tracts sold early in the time horizon, but fewer tracts sold later when prices are higher and technology improves. Multi-round auctions lead a smaller average number bids per tract as more marginal tracts are bid upon and sold, and these tracts typically receive only a single bid. Revenue sharing with coastal states and onshore expenditures both decrease with multi-round auctions, but this effect is offset by lower environmental and social costs.

Work Commitment increases exploratory activities on tracts sold, but the need to commit to higher exploration activity decreases tract values, and therefore reduces cash bonus bids and the number of tracts sold. The higher level of exploratory effort results in slightly more fields discovered, but many of those fields are small and only marginally productive. Work commitment decreases measures of obtaining fair market value and has offsetting effects on regional planning costs. But work commitment has an overall negative effect on the social value of OCS resources by decreasing all sources of revenues, while having a small, but insignificant, reduction in lost resources.

Shorter Lease Terms are found to adversely affect most measures of expediting development of OCS resources, and to reduce the overall social value of OCS resources. In effect, a shorter lease term reduces the effectiveness of tract exploration, such that fields go undiscovered during exploration, and the associated tracts are resold in the future. By the same token, a shorter lease period is forecast to increase area rental payments, but is otherwise expected to reduce revenues associated with OCS leasing. And a shorter lease period is expected to reduce the number of bids received, thereby decreasing competition for tracts. A shorter lease term slightly reduces revenue sharing with coastal states, significantly decreases state revenues associated with onshore expenditures, and reduces environmental and social costs. The model concludes that regional planning is facilitated by shorter lease terms, except that more tracts are sold due to re-sales of unsuccessful tracts, which might partially offset otherwise reduced planning costs.

Effects of Federal Leasing Policy on Revenues of Coastal States

Although we were unable to carry out a thorough study of the issue, we also explored the extent to which Areawide leasing could potentially harm coastal states by "flooding the market" with OCS leases, thereby reducing revenues from leasing in State waters. Our analysis uses Louisiana as a case study.

Louisiana is a mature oil and gas region, and its state waters have been well explored. Production from offshore Louisiana has been decreasing since 1970, well before the advent of Areawide

leasing. Nearshore Federal waters also have been well explored. A large and increasing fraction of Federal OCS operations occur far offshore. The technologies and equipment used for deepwater operations differ enormously from those in State waters. Transferability of equipment, technology and skilled personnel between near shore and deepwater offshore areas is likely to be very limited. As a consequence, current and future operations in Federal waters and Louisiana state waters are, by and large, not likely to be close substitutes.

Data support this notion that OCS oil and gas and petroleum operations in Louisiana state waters are not close substitutes. A comparison of firms bidding in lease sales in Federal and State water shows relatively little overlap among participating bidders. And participants in federal lease sales show relatively low intensity in bidding for State of Louisiana tracts.

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I. Introduction

This Summary Report is Part 1 of a 2 part report on a study of alternative policies for Outer Continental Shelf (OCS) oil and gas leasing. The Summary Report briefly outlines the methodologies employed, and discusses the results and conclusions of an extensive study designed to quantify the effects of alternative leasing policies for Outer Continental Shelf (OCS) oil and gas resources in the Central and Western Gulf of Mexico. The potential effects which we examine include variations in the levels of exploration, production, revenues and other impacts associated with OCS Development. We also explore the issue of whether Areawide leasing for the OCS reduces the returns to leasing in the waters of coastal states, using Louisiana as an example.

This Summary Report provides a non-technical overview of a more extensive Technical Report developed by the authors on behalf of the U.S. Mineral Management Service (Opaluch, et al, 2009). The interested reader is referred to the Technical Report for a more detailed description of the methods and data.

I.A. Background and Issues

OCS hydrocarbon resources are a major source of national energy supplies, providing about 23% of domestic oil and 16% of natural gas in 2005. OCS lease sales are also an enormous source of national wealth, with cash bonus bids totaling over $65 billion dollars through 2006 (MMS, 2007), and the net economic value of leasable resources estimated at $145 billion just for the Central and Western Gulf of Mexico (hereinafter "GOM", unless otherwise noted) (U.S. Minerals Management Service, 2006).

Leasing of OCS hydrocarbons is largely guided by the OCS Lands Act, as amended through PL106-580 (OCSLA). Most leases for oil and gas resources in federal waters are sold using sealed cash bonus bids along with an annual per acre rental until production begins, and a fixed

16 2/3% royalty (and more recently, an 18.75% royalty) on the value of produced oil and gas. Prior to 1983, lease sales were conducted under a process of nominations by industry to identify tracts of interest. Following comments by other interested parties, such as coastal states, fishery, and environmental interests, MMS determined the set of tracts that comprised the lease sale, which were typically on the order of a couple of hundred tracts. Since 1983, however, offshore leasing has been carried out under a process called Areawide leasing, whereby nearly all blocks available for leasing in a region are offered for sale. A single sale might contain over 5,000 tracts, although only small fraction might actually receive bids. For tracts receiving fewer than 3 bids, the MMS carries out a fair market value review before deciding whether or not to grant a lease. Hence, not all tracts receiving bids are leased; unleased tracts typically are included in subsequent sales when higher prices, lower costs, or additional information might make the tracts financially viable.

The Areawide process has been criticized for reducing competition for tracts, thereby lowering returns for the federal government, as well as for coastal states which hold their own lease sales (e.g., Stiglitz, 1984; GAO, 1985; Moody and Kravavant, 1990, Moody, 1994; Gelso, 2008). But others have argued that there is no evidence that the increased pace of leasing has reduced revenues from offshore leasing (e.g., Farrow, 1987), especially when one considers the present value of all sources of revenues from OCS leasing, including not only cash bonus bids but also rentals, royalties, taxes, etc. (U.S. Department of Energy,1985). Furthermore, critics have charged that it has been over two decades since there has been experience in federal lease sales with approaches other than cash bonus bids with fixed royalty rates, and that the economic conditions which were used as the rationale for adopting an Areawide leasing policy may now be seriously out of date.

It may be that the current leasing approach is, on balance, the best approach for achieving the goals of the OCSLA. However, the OCSLA allows the MMS to use other leasing systems, and there is also considerable experience with many other oil and gas leasing options at the state level, for federal onshore resources, in other countries, and for resources other than oil and gas. Thus, it has been argued that it is time to consider alternatives to Areawide leasing.

A comparative analysis of alternative leasing policies is well justified, given the significance of OCS oil and gas resources, and the absence of recent studies which systematically compare policies. Adding to the impetus for a major study of OCS leasing options are dramatic changes in offshore technology, which allow operations in deep (and now “ultra deep”) waters; highly volatile oil prices, which exacerbate an uncertain and risky investment environment; increasing national security concerns for added domestic sources of energy in support of energy security; complications caused by royalty relief for deep and ultra deep wells; and potential for an increased role of coastal states in the leasing program under various ongoing Congressional Initiatives.

This study was designed to compare alternative designs of leasing systems for OCS oil and gas resources in the Central and Western Gulf of Mexico. Our assessment focuses on the Gulf of Mexico and, in particular, on the Central (CGOM) and Western Gulf of Mexico (WGOM) planning areas. For convenience, however, these two areas are simply referred to in the text as the GOM, unless otherwise stated. We also note that while the analysis herein may have implications for other OCS areas, only the CGOM and the WGOM are explicitly considered in

this report. The focus is on offshore tracts to be leased over the 50-year period from 2010 - 2060. We note that issues involving royalty relief are outside the scope of this effort.

I.B. Organization

This report is organized around the three main Tasks of the Project. Task 1 identifies lease options, and specifies Goals and Criteria for assessing the policy alternatives. Next, we provide an overview of Task 2 of the study, which is comprised of a set of technical analyses used to quantify the Criteria specified in Task 1. Then in Task 3, we use the results of Task 2 to assess each of the policy alternatives relative to current leasing policy. After that, we explore whether Areawide leasing results in conflicts with leasing in GOM state waters, using Louisiana as a case study. Finally, we present the recommendations and conclusions of the study, as well as important qualifications.

II. Overview of the Study

This Section summarizes the methods employed to assess alternative OCS oil and gas leasing policies for the GOM. An integrated approach is used for simulating alternative policies for OCS leasing, accounting for geological, technological, commercial, economic, and environmental factors. The approach relies on a simulation model which specifies various scenarios for OCS lease sales, and forecasts the resultant OCS activity, including number of leases sold, wells drilled, platforms put in place, oil and gas produced and revenues received. A variety of other impacts are also considered in the model, including environmental and social costs as well as direct, indirect and induced economic impacts on coastal counties.. Overall, the approach has several unique features, including the following:

(1) Use of a resource inventory approach for including field discovery and depletion, based on MMS estimates of presently undiscovered fields by field size and water depth,

(2) Industry-specific technological advances in OCS exploration, development and production (Managi et al., 2004; 2005),

(3) A probabilistic approach to forecasting the size of new discoveries that balances the numbers of undiscovered fields within different size classes and the difficulty of finding a field of a given size,

(4) Use of an economic experiment to examine the potential adaptation of multi-round bidding, an approach never used for OCS oil and gas leasing, but which has been used by the Federal Communications Commission to auction electromagnetic frequencies, and

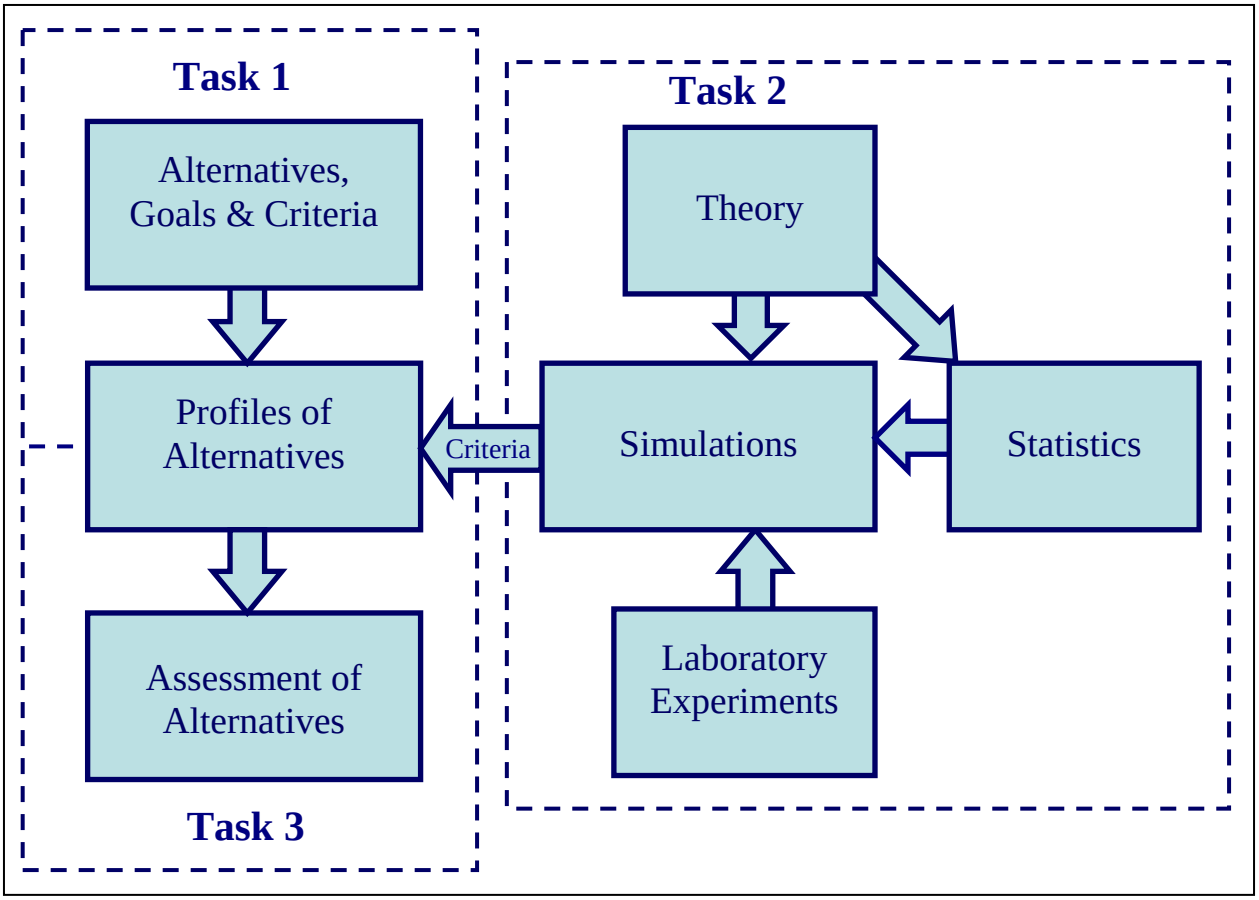
(5) Integration of items (1) – (4) in a single OCS leasing policy model system which provides estimates of OCS activities and a variety of effects, as noted above.

The study is based on three main integrated Tasks, as is depicted in Figure 1, and described briefly in the Sections which follow. Task 1 identifies alternative leasing systems, and outlines a set of Goals for OCS leasing based on those indicated in the OCSLA and other considerations. Task 1 also develops a set of measureable Criteria for assessing the extent to which each policy alternative achieves those Goals.

Task 2 develops the modeling approach which quantifies (when possible) the Criteria developed in Task 1. And Task 3 uses the output of Task 2 to assess each policy option relative to the status quo policy of Areawide leasing.

This summary report briefly explains each of these tasks in a non-technical manner. Readers interested in more details should consult the Technical Report (Opaluch, et al., 2009). To assist readers, the discussion of the various study elements in the Summary Report refers to the Section of the Technical Report where more detailed information can be found.

Figure 1 Project Overview



II.A. Task 1: Leasing System Alternatives, Goals and Criteria

Task 1 identifies a set of alternative policies that could potentially be used for OCS leasing. Task 1 also identifies a set of Goals for OCS leasing policy, and a set of Criteria that are used to assess the extent to which each policy option contributes to each Goal. First, however, we discuss how we identified the policy options that were ultimately assessed using our quantitative simulation approach. As used here, alternative leasing systems include both the pace at which leasing occurs, as well as the financial terms and conditions under which individual tracts are leased.

II.A.1. Identification of Policy Alternatives

The identification of OCS leasing systems for detailed study involved a two-step process to identify OCS leasing systems for detailed study. First, we cast our net broadly and considered auction approaches used in a variety of contexts, both within and, to a lesser extent, outside of the United States. For the second step, we used a set of pragmatic criteria to identify a subset of options that were deemed to be practical and potentially desirable.

The initial "long list" of candidate leasing systems included over 50 options. The second step reduced this long list to a more manageable number for detailed study using pragmatic criteria, including consistency with the OCSLA, transactions costs, protection of the integrity of the OCS leasing process, and other factors. For example, we excluded from our analysis leasing alternatives specifically prohibited by the OCSLA, such as the use of more than one bid variable or the leasing of tracts larger than 5,760 acres.

Table 1 lists the major policy alternatives for leasing that were considered for full quantitative assessment in Task 2. It should be clear that a great many permutations of these policies could be used. Hence, the assessment of the performance of even the relatively small number of leasing alternatives in the short list involves a substantial effort and several technical challenges, as explained in the Technical Report.

As indicated above, the performance of each policy alternative is ultimately assessed relative to the performance of the status quo, the current Areawide system. The specific status quo lease sale terms and conditions we employ are the terms and conditions used in Central Gulf of Mexico lease sale #206, which was held on March 19, 2008, detailed below.

II.A.2. Goals and Criteria

Task 1 also identifies a set of Goals for the OCS leasing process, and an associated set of Criteria that are used to assess the extent to which each policy alternative satisfies each Goal. The Goals represent the objectives or "ends" of OCS leasing policy. Because no single Goal captures well the performance of alternative OCS oil and gas leasing systems in achieving the overall objectives of OCS policy, multiple Goals are used. Our selected Goals start with those specifically included in the OCSLA, such as Expeditious and Orderly Development of OCS Resources, Obtain Fair Market Value for Leased Resources, Promote Competition, Equitable Sharing of Costs and Benefits, Facilitate Regional Planning and Minimize Environmental Risks to Coastal States. We also add a small number of other Goals which are also highly relevant, although not specifically mentioned in the OCSLA, such as Maximize Social Value and Protect

Table 1 Lease Policy Alternatives Considered in the Analysis

1	-	Slower Pace of Leasing (4,000 Tracts in 2010)
2	-	Slower Pace of Leasing (400 Tracts in 2010)
3	-	Lower Royalty Rate (12.5%)
4	-	Higher Royalty Rate (35%)
5	-	Sliding Scale Royalty Rate (35% reducing linearly with production to 12.5% for last 25% of production)
6	-	Higher Minimum Bid (5x Status Quo)
7	-	Profit Share with Royalty (30% Profit Share, 18.75% Royalty)
8	-	Profit Share in Lieu of Royalty (30% Profit Share, No Royalty)
9	-	Higher Area Rental Fee (5x Status Quo)
10	-	Multi-Round Auction
11	-	Work Commitment
12	-	Shorter Lease Term (75% of Status Quo Lease Term)

the Integrity of the Leasing Process. The latter Goal is especially important, but is one based on qualitative, rather than quantitative, considerations.

Next, we specify a set of Criteria that provide quantifiable measures of the extent to which a leasing system can potentially satisfy each Goal. Again, in most cases a single Criterion will not fully reflect the achievement of a particular Goal. For example, consider the OCS leasing Goal, Expeditious and Orderly Development. To assess how a proposed leasing system would perform in achieving this Goal, the specific Criteria used include the number of tracts offered for sale, the number of tracts sold, the number of fields discovered, and the amount of oil and gas produced. In all, over 30 Criteria are employed for the OCS policy Goals identified (Table 2).

A single leasing system is unlikely to dominate all others for all Goals and Criteria. Instead, we would expect some leasing systems to perform better for some Criteria and less well for others. For example, a leasing system with a higher fixed royalty (e.g., 35% royalty) than the status quo (18.75% royalty) might increase royalty payments but reduce bonus bids and decrease total production relative to the status quo leasing system.

We do not assign weights to reflect the relative importance of different leasing Goals and Criteria, nor do we recommend a particular leasing system. Instead, we assess how alternative systems might perform as compared with the current leasing approach in terms of the specific Goals and Criteria adopted for use in this study. We emphasize that the period covered in the study is for lease sales occurring between 2010 – 2060, and for the associated production which can extend far beyond 2060.

II.B. Task 2: Simulation Model and Supporting Analyses

Task 2 develops quantitative forecasts of the effects of alternative leasing policies on each of the Goals and Criteria that are identified in Task 1. This quantitative output is used to assess lease policy alternatives in Task 3. The central component of the Task 2 analyses is a Simulation Model. The model is used to forecast tracts sold, exploration, discovery, production, revenues, etc., under each of the alternative leasing policies for tracts leased over the 50 year period, 2010 - 2060. The Simulation model has two major components: a Field model and an Area model. As the names suggest, the Field model simulates activity at the oil or gas field level, while the Area model aggregates these activities across all fields in the GOM for leases offered for sale during the study period.

II.B.1. The Field Model

As detailed below, the Field model is a detailed, computerized representation of the exploration, development, and production of oil and natural gas fields in the GOM. It substantially updates and refines earlier work by Jin and Grigalunas (1993). Inputs to the Field model include field size, water and drilling depths, dry hole rates, timing of exploration and development, annual production profiles, prices, royalty rates, other direct costs, indirect costs, and tax rates. The Field model then is used to simulate management of individual fields for a representative set of fields in the GOM. These fields include 16 size classes, each in 7 distinct water depths, of two types (oil vs. gas), for a total of 224 representative fields.

Table 2 List of Goals and Associated Criteria

Goal 1. Expeditious and Orderly Development of OCS Resources

- Total Production (BBOE)
- Discounted Production (BBOE)
- Fields Developed
- Exploration Wells
- Development Wells
- Production Wells
- Ave. Annual Number of Tracts Offered
- Average Annual Tracts Sold

Goal 2. Obtain Fair Market Value for Leased Resources

- Discounted High Bids
- Discounted Royalties
- Discounted Area Rental Payments
- Discounted Profit Share
- Total Discounted OCS Revenues
- Discounted Federal Taxes
- Total Discounted Revenues

Goal 3. Promote Competition

- Bids per Tract

Goal 4. Equitable Sharing of Costs and Benefits of Offshore Leasing

- Revenue Sharing with Coastal States
- Discounted State Revenues Onshore
- Discounted Environmental/Social Costs

Goal 5. Facilitate Regional Planning and Minimize Env. Risks

- Discounted Environmental/Social Costs
- Number of Tracts Offered
- Number of Tracts Sold
- Total Discounted Production
- Number of Field Discovered

Goal 6. Maximize Social Value

- Discounted Leasing Revenues
- Discounted Federal Taxes
- Discounted Profit
- Total Discounted Revenues
- Discounted Lost Resources
- Total Discounted Production

Goal 7. Protect Integrity of the Leasing Process

- Qualitative Criteria Only

The Field model simulates field activities over the life of each field through shutdown, and forecasts the timing and amounts of associated wells drilled, platforms constructed, resources produced, revenues generated, etc., for each of the 224 representative fields. The model is used to estimate the economic feasibility of developing OCS fields of different sizes and the after-tax net present value of developed fields. The model also provides estimates of the number of wells drilled and platforms installed as well as the annual output of oil and gas from primary and secondary recovery for each field though field shutdown and abandonment. Also estimated in the model are rental, royalty, and federal tax payments over the life of the field. The interested reader can find a more detailed discussion of the Field model in Section III.A of the Technical Report.

II.B.2. The Area Model

The Area model starts with scenarios for lease policies, economic conditions, and undiscovered, leasable resources, and uses statistical analyses to forecast the number of tracts sold. The number of tracts sold and economic conditions are then used to estimate the number of exploratory wells drilled on each tract for the same set of 16 size categories and 7 water depths indicated above. Dry hole rates are then used to estimate the number of successful discoveries by field size and water depth. The output of the Field model is then used to forecast production, revenues, and other key measures for each of these newly discovered fields. New discoveries at that time period are deducted from the remaining set of undiscovered resources, and the Area model then progresses to the next time period. This stepwise process continues through the entire time horizon.

We assume a 7% discount rate, and the initial oil price considered in the simulation model is $90 per barrel, and is assumed to increase annually at 2% in real terms. We also consider sensitivity analyses with starting prices of oil at $50 and $120 per barrel, which are also assumed to increase at a real rate of 2% per year. Other data and key parameters and assumptions in the field simulation can be found in Section III.A of the Technical Report.

The Field model used in this study has several important and novel features, as outlined above. One is that technological advances in OCS exploration and development are specifically included, drawing from the work of Managi, et al. (2004, 2005). All else equal, improvements in technology lower the input requirements for exploration, development, and production, and increase the amount of resources potentially extracted.

The second novel feature is that the analysis incorporates a statistical (Bayesian) approach to calculating and updating the probability distribution on the size of discoveries of new fields each year. The approach balances two effects. Large fields are assumed, on average, to be associated with larger geologic formations, which could make an individual large field easier to discover than an individual small field. But at the same time, there are more small fields than large fields. Our approach incorporates these two effects into the probability distribution on the size of newly discovered fields, which is described in Section III.A.2.e of the Technical Report.

Once discovered, fields are dropped from the inventory of remaining undiscovered fields, which accounts for field depletion over time. Discovered fields found to be commercially infeasible at current prices and costs are returned to the inventory of resources, making them available for

future leasing and exploration. The feasibility of finding and developing fields improves over time with technological progress and increasing real oil prices.

Statistical analyses are used to quantify three key equations. First, we use MMS data from past OCS lease sales from 1954-2008 to estimate the number of leases sold as a function of the number of leases offered and the prevailing oil price, net of the royalty. This important equation allows us to determine how leasing policy (e.g., number of leases offered) and economic conditions (e.g., oil prices) determine the number of tracts sold in each forecast year.

The next key statistical equation determines the number of bidders on each tract as a function of the net present value of the tract and the policy regarding the number of tracts offered. The third key equation -- the bid function -- estimates the high bid on a tract as a function of the tract value and the number of tracts offered for sale. Together, the three equations are used to forecast (1) tracts sold, (2) numbers of bidders, and (3) high bids resulting from alterative lease policies. This information we use later to assess the performance of a policy in achieving such Goals as expediting exploration and development, fair market value, and competition. The details of the statistical analyses are described in Section III.C of the Technical Report.

In addition to our use of statistical analyses of past OCS lease sales, laboratory experiments are used to calibrate the empirical bid function in order to assess the potential for one novel bidding approach for which no historic data exist for OCS leasing—a multi-round bidding structure.

We adopt a multi-round process based, in part, on the approach used by the Federal Communications Commission in auctioning the right to use the electromagnetic spectrum for cell phone transmissions. The comparative results of these two treatments are then used to calibrate the statistically estimated bid function to provide a perspective on the potential for multi-round leasing applied to OCS leasing. We also carry out experiments in more competitive and less competitive environments to assess the relative performance of multi-round leasing under Areawide leasing with large numbers of tracts offered for sale, and in a lease environment where fewer tracts are offered, such as under nomination leasing. The laboratory experiments applied to multi-round auctions are described in detail in Section III.D of the Technical Report.

II.C. Specification of the Status Quo

The pace of leasing under the status quo scenario is based on historic numbers of tracts offered for sale in the Central and Western Gulf of Mexico, as reported in MMS (2009a). With the advent of Areawide leasing in 1983, the number of tracts offered for sale in the GOM increased dramatically. For example, in the five years prior to the transition to Areawide leasing, an average of about 336 tracts were offered for sale each year in the Central and Western Gulf of Mexico. The data also show the number of tracts offered each year under Areawide leasing has been declining since 1983. The number of tracts offered for sale has decreased from about 13 thousand tracts in 1983 to slightly less than 9 thousand in 2008. We ran a logarithmic regression of the number of tracts offered in the Central and Western Gulf of Mexico on a time trend, and found an average historic rate of decline of about 1.56% per year from 1983 through 2008. We adopt this estimated rate of decline in number of tracts offered for sale for all of our scenarios.

Our base case scenario assumes leasing commences in 2010 with 8,000 tracts offered for sale, and that tracts offered decline over time at 1.56% per year, to approximately 3,746 tracts offered at the end of the 50-year time horizon. All scenarios presented in this report are based on a 7% discount rate and a $90 starting price for oil with an annual 2% real rate of increase. The other leasing terms and conditions under the status quo are based on those for Sale # 206 in the Central Gulf of Mexico, as indicated in Table 3.

Table 3 Status Quo Policy: Lease Terms and Conditions for Sale #206 in the CGOM

- Area-wide Leasing
- Minimum cash bonus per acre:
  $25/acre for water depth < 400 meters
  $37.50/acre for water depth ≥ 400 meters
- Royalty: 18 ¾% for all water depths
- Rental:
  $6.25/acre for water depth of < 200 meters
  $9.50/acre for water depth of ≥ 200 meters
- Minimum Royalty
  $6.25/acre for water depth of < 200 meters
  $9.50/acre for water depth of ≥ 200 meters
- Initial term of lease
  5 years for water depth < 400 meters
  8 years for water depth ≥ 400 meters to < 800 meters
  10 years for water depth ≥ 800 meters

III. Assessment of the Policy Alternatives

This Section discusses the results of Task 3, in which we apply the model from the Task 2 analyses (described in Section II.B. above) to assess the leasing alternatives in terms of the Goals and Criteria developed in Task 1. First, we discuss the details of our specification of the policy alternatives, and the measures of the various Criteria. Then, we present the results of the analysis of the policy alternatives.

III.A. Specification of Policy Alternatives

As a reminder, Table 1 above lists the policy changes we consider for the pace of leasing and the tract leasing terms and conditions. We consider two policy alternatives that modify the pace of leasing relative to the 8,000 tracts offered in 2010 under the status quo. Our first scenario reduces the pace of leasing by 50%, with 4,000 tracts offered per year in 2010. Next, we consider a scenario that reduces the pace of leasing to 400 tracts offered in 2010, which is intended to represent a return to the pre-Areawide leasing program. All of our scenarios for the pace of leasing assume that the number of tracts offered for sale decline over time at that same rate of 1.56% per year that has been observed historically.

Next we consider alternatives to the status quo royalty rate of 18.75%. We consider an alternative that reduces the royalty rate to 12.5%, the minimum allowable under OCSLS, and an alternative that increases the royalty rate to 35%. Also considered is a sliding scale royalty rate that starts at 35% and decreases linearly with production, until it reaches 12.5% for the final 25% of production from each field. The rationale for this sliding scale royalty is to capture revenues by starting with a high royalty rate, while at the same time attempting to avoid overly distorting the incentive for early shutdown by reducing the royalty rate as the field is depleted.

Then we consider two scenarios for profit share. The first scenario involves adding a 30% profit share to the base case leasing conditions. The second scenario involves using a 30% profit share in lieu of royalty payments—that is 30% profit share with a 0% royalty rate. We also consider an alternative that increases the minimum acceptable bid by a factor of 5 relative to the status quo policy, where the minimum bid is $25 per acre in water less than 400 meters and $37.50 per acre in water greater than 400 meters. The next policy increases the status quo area rental rate by a factor of 5, to $31.25 per acre for shallower tracts and $47.50 per acre for deeper tracts. Then we examine a policy that imposes a work commitment on exploration, which we implement by requiring double the exploration effort as would occur without a work commitment.

Finally we consider a multi-round bidding system which represents a more significant departure from the status quo auction rules. The multi-round approach we examine is similar in many respects to the approach used by the Federal Communications Commission for leasing rights to the electromagnetic spectrum. Under multi-round bidding, tracts are sold by sealed bids, but bidding continues for multiple rounds, with the provisional winning bids on each tract being announced at the end of each round. Trading continues as long as new, higher bids are received. The multi-round bidding system is discussed in more detail in Section III.D of the Technical Report.

III.B. Assessment of Policy Alternatives

Each of the leasing policies discussed above is evaluated relative to the status quo leasing policy using the Goals and Criteria discussed above. While some interested parties may place greater emphasis on some Goals than others, we make no quantitative tradeoffs across the Goals, but rather note how effective the various options are in achieving each of the Goals.

Prior to discussing the results in detail, the reader should be reminded that many of the policies considered below are well outside the range of experience within the past 25 years. Indeed, we have no experience in OCS leasing whatsoever with some of the policies that we assess below. And many of the results discussed below reflect numerous offsetting effects. Thus, while the results given here are quantitative, the reader is cautioned to interpret the results with care, given the long time horizon and the extensive uncertainties involved at virtually every stage.

Given these uncertainties, we believe the results are best viewed as indicators of likely incremental effects of policies, and not as precise quantitative predictions of actual policy outcomes. Thus, we prefer to utilize the results to identify strengths and weaknesses of policies, including whether one might expect differences across policies to be "substantial", "modest" or "small". In cases where we find small differences across policy alternatives, the results should not be interpreted to suggest one option is demonstrated to be clearly superior to the other. Rather small differences should be taken as an indicator that major differences should not be expected across the two alternatives.

In a similar vein, a reader might also be tempted to ask questions such as whether the effect of a particular policy (e.g., increasing royalty payments) is larger or smaller in percentage terms when combined with some other policy (e.g., slowing the pace of leasing). This type of question relates to interaction effects among policies, which might be termed "second order" effects. While certainly the model can be run to quantify these sorts of interaction effects, we have resisted considering such scenarios in this report due to a concern that the inherent uncertainties and the long time horizon imply that data are not sufficient to support such a demanding and precise interpretation of the results. Thus, we prefer to interpret the results as qualitative "first order" indictors of the size and direction of incremental effects of a particular policy. If one were interested in combining policies, we view our results simply as cumulative. For example, if one policy reduces revenues and another policy also reduces revenues, then we would conclude that revenues are reduced by "more" if the policies are combined, without attempting to quantify how much more. That is, we make no attempt to assess whether the incremental effect of some particular policy is larger or smaller when some other policy is also in place.

With those caveats in mind, the empirical results provide many useful insights into potential effects of the various policy alternatives (see Table 4). First and foremost, the results show that there are important tradeoffs across policy alternatives, so no single policy is best at achieving all Goals. Nor does any individual policy dominate the status quo policy. Rather, some policy alternatives perform better than the status quo in terms of some Goals, but not as well in terms of other Goals. So choice among policies depends upon value judgments regarding the relative importance of the various Goals.

Table 4. Assessment of Criteria Under Alternative Lease Sale Scenarios

Goal 1. Expeditious and Orderly Development of OCS Resources

Alternatives 1-6

Critera	Status Quo Current Leasing System	Alternative 1 Fewer Tracts Offered (4,000)	Alt. 2 Fewer Tracts Offered (400)	Alt 3 Decrease Royalty to 12.5%	Alt. 4 Increase Royalty to 35%	Alt 5. Sliding Scale Royalty (35% to 12.5%)	Alt. 6 Higher Minimum Bid
Total Production (MMBOE)	22,113	21,997	24,468	25,657	17,251	19,131	21,991
Discounted Production (MMBOE)	3,733	3,567	3,297	4,415	2,907	3,199	3,537
Fields Discovered	954	901	711	960	936	952	891
Exploration Wells	10,931	9,478	5,740	11,108	10,412	10,866	9,219
Development Wells	5,267	5,140	5,251	5,948	4,219	4,638	5,119
Production Wells	11,467	11,200	11,633	13,160	9,487	10,288	11,156
Ave. Annual Number of Tracts Offered	5,598	2,799	280	5,598	5,598	5,598	5,598
Average Annual Tracts Sold	119	85	26	119	118	119	79

Alternatives 7-12

Critera	Status Quo Current Leasing System	Alt. 7 Profit Share (30%) Royalty 18.75%	Alt. 8 Profit Share (30%) No Royalty	Alt. 9 Higher Area Rental Fee	Alt.10 Multi-Round Bidding	Alt. 11 Work Commit-ment	Alt. 12 Shorter Lease Term
Total Production (MMBOE)	22,113	22,113	32,453	21,437	22,013	21,090	22,000
Discounted Production (MMBOE)	3,733	3,733	5,609	3,469	3,601	3,734	3,495
Fields Discovered	954	954	971	900	912	1,023	876
Exploration Wells	10,931	10,931	11,432	9,452	9,765	17,567	8,855
Development Wells	5,267	5,267	7,354	5,041	5,165	5,195	5,091
Production Wells	11,467	11,467	16,288	11,014	11,253	11,371	11,100
Ave. Annual Number of Tracts Offered	5,598	5,598	5,598	5,598	5,598	5,598	5,598
Average Annual Tracts Sold	119	119	120	84	170	78	135

Table 4. Assessment of Criteria Under Alternative Lease Sale Scenarios (Con't)

Goal 2. Obtain Fair Market Value for Leased Resources

Alternatives 1-6

Critera	Status Quo	Alternative 1	Alt. 2	Alt 3	Alt. 4	Alt 5.	Alt. 6
	Current Leasing System	Fewer Tracts Offered (4,000)	Fewer Tracts Offered (400)	Decrease Royalty to 12.5%	Increase Royalty to 35%	Sliding Scale Royalty (35% to 12.5%)	Higher Minimum Bid
Discounted High Bids	$ 31,464	$ 35,239	$ 47,923	$ 37,458	$ 19,278	$ 26,211	$ 31,386
Discounted Royalties	$ 44,290	$ 42,626	$ 41,336	$ 35,326	$ 67,804	$ 53,079	$ 43,543
Discounted Area Rental Payments	$ 5,579	$ 2,919	$ 337	$ 5,593	$ 5,537	$ 5,574	$ 4,178
Discounted Profit Share							
Total Discounted OCS Revenues	$ 81,333	$ 80,784	$ 89,595	$ 78,377	$ 92,619	$ 84,863	$ 79,106
Discounted Federal Taxes	$ 24,541	$ 24,403	$ 20,632	$ 29,580	$ 15,756	$ 20,465	$ 28,136
Total Discounted Revenues	$ 105,874	$ 105,187	$ 110,227	$ 107,957	$ 108,374	$ 105,328	$ 107,243

Alternatives 7-12

Critera	Status Quo	Alt. 7	Alt. 8	Alt. 9	Alt.10	Alt. 11	Alt. 12
	Current Leasing System	Profit Share (30%) Royalty 18.75%	Profit Share (30%) No Royalty	Higher Area Rental Fee	Multi-Round Bidding	Work Commit-ment	Shorter Lease Term
Discounted High Bids	$ 31,464	$ 22,659	$ 37,499	$ 29,395	$ 24,601	$ 30,735	$ 29,743
Discounted Royalties	$ 44,290	$ 44,290	$ -	$ 41,710	$ 42,963	$ 44,444	$ 41,922
Discounted Area Rental Payments	$ 5,579	$ 5,579	$ 5,618	$ 14,416	$ 9,819	$ 2,304	$ 6,340
Discounted Profit Share		$ 8,700	$ 20,204				
Total Discounted OCS Revenues	$ 81,333	$ 81,228	$ 63,320	$ 85,521	$ 77,382	$ 77,483	$ 78,005
Discounted Federal Taxes	$ 24,541	$ 17,042	$ 28,616	$ 22,281	$ 25,685	$ 20,054	$ 25,152
Total Discounted Revenues	$ 105,874	$ 98,270	$ 91,936	$ 107,801	$ 103,068	$ 97,537	$ 103,157

Dollar Values are Expressed in Millions of 2003 Dollars

Table 4. Assessment of Criteria Under Alternative Lease Sale Scenarios (Con't)

Goal 3. Promote Competition

Alternatives 1-6

Critera	Status Quo	Alternative 1	Alt. 2	Alt 3	Alt. 4	Alt 5.	Alt. 6
	Current Leasing System	Fewer Tracts Offered (4,000)	Fewer Tracts Offered (400)	Decrease Royalty to 12.5%	Increase Royalty to 35%	Sliding Scale Royalty (35% to 12.5%)	Higher Minimum Bid
Bids per Tract	1.26	1.36	2.04	1.29	1.20	1.24	1.30

Alternatives 7-12

Critera	Status Quo	Alt. 7	Alt. 8	Alt. 9	Alt.10	Alt. 11	Alt. 12
	Current Leasing System	Profit Share (30%) Royalty 18.75%	Profit Share (30%) No Royalty	Higher Area Rental Fee	Multi-Round Bidding	Work Commit-ment	Shorter Lease Term
Bids per Tract	1.26	1.23	1.30	1.36	1.18	1.40	1.22

Table 4. Assessment of Criteria Under Alternative Lease Sale Scenarios (Con't)

Goal 4. Equitable Sharing of Costs and Benefits of Offshore Leasing

Alternatives 1-6

Critera	Status Quo	Alternative 1	Alt. 2	Alt 3	Alt. 4	Alt 5.	Alt. 6
	Current Leasing System	Fewer Tracts Offered (4,000)	Fewer Tracts Offered (400)	Decrease Royalty to 12.5%	Increase Royalty to 35%	Sliding Scale Royalty (35% to 12.5%)	Higher Minimum Bid
Revenue Sharing with Coastal States*	$ 20,556	$ 19,982	$ 21,522	$ 17,530	$ 28,511	$ 23,494	$ 19,493
Onshore Economic Impacts	$ 27,925	$ 24,012	$ 16,524	$ 29,911	$ 24,731	$ 26,953	$ 23,805
Discounted Environmental/Social Costs	$ 256	$ 245	$ 226	$ 303	$ 200	$ 220	$ 243

Alternatives 7-12

Critera	Status Quo	Alt. 7	Alt. 8	Alt. 9	Alt.10	Alt. 11	Alt. 12
	Current Leasing System	Profit Share (30%) Royalty 18.75%	Profit Share (30%) No Royalty	Higher Area Rental Fee	Multi-Round Bidding	Work Commit-ment	Shorter Lease Term
Revenue Sharing with Coastal States*	$ 20,556	$ 26,225	$ 5,295	$ 21,660	$ 20,379	$ 19,526	$ 19,961
Onshore Economic Impacts	$ 27,925	$ 27,925	$ 33,680	$ 24,165	$ 25,101	$ 40,111	$ 22,953
Discounted Environmental/Social Costs	$ 256	$ 256	$ 385	$ 238	$ 247	$ 256	$ 240

*Revenue Sharing Calculations Do Not Consider $500M Annual Limit

Dollar Values are Expressed in Millions of 2003 Dollars

Table 4. Assessment of Criteria Under Alternative Lease Sale Scenarios (Con't)

Goal 5. Facilitate Regional Planning and Minimize Env. Risks

Alternatives 1-6

Critera	Status Quo	Alternative 1	Alt. 2	Alt 3	Alt. 4	Alt 5.	Alt. 6
	Current Leasing System	Fewer Tracts Offered (4,000)	Fewer Tracts Offered (400)	Decrease Royalty to 12.5%	Increase Royalty to 35%	Sliding Scale Royalty (35% to 12.5%)	Higher Minimum Bid
Discounted Environmental/Social Costs	$ 256	$ 245	$ 226	$ 303	$ 200	$ 220	$ 243
Number of Tracts Offered	5,598	2,799	280	5,598	5,598	5,598	5,598
Number of Tracts Sold	119	85	26	119	118	119	79
Total Discounted Production	3,733	3,567	3,297	4,415	2,907	3,199	3,537
Number of Field Discovered	954	901	711	960	936	952	891

Alternatives 7-12

Critera	Status Quo	Alt. 7	Alt. 8	Alt. 9	Alt.10	Alt. 11	Alt. 12
	Current Leasing System	Profit Share (30%) Royalty 18.75%	Profit Share (30%) No Royalty	Higher Area Rental Fee	Multi-Round Bidding	Work Commit-ment	Shorter Lease Term
Discounted Environmental/Social Costs	$ 256	$ 256	$ 385	$ 238	$ 247	$ 256	$ 240
Number of Tracts Offered	5,598	5,598	5,598	5,598	5,598	5,598	5,598
Number of Tracts Sold	119	119	120	84	170	78	135
Total Discounted Production	3,733	3,733	5,609	3,469	3,601	3,734	3,495
Number of Field Discovered	954	954	971	900	912	1,023	876

Dollar Values are Expressed in Millions of 2003 Dollars

Table 4. Assessment of Criteria Under Alternative Lease Sale Scenarios (Con't)

Goal 6. Maximize Social Value

Alternatives 1-6

Critera	Status Quo	Alternative 1	Alt. 2	Alt 3	Alt. 4	Alt 5.	Alt. 6
	Current Leasing System	Fewer Tracts Offered (4,000)	Fewer Tracts Offered (400)	Decrease Royalty to 12.5%	Increase Royalty to 35%	Sliding Scale Royalty (35% to 12.5%)	Higher Minimum Bid
Discounted Leasing Revenues	$ 81,333	$ 80,784	$ 89,595	$ 78,377	$ 92,619	$ 84,863	$ 79,106
Discounted Federal Taxes	$ 24,541	$ 24,403	$ 20,632	$ 29,580	$ 15,756	$ 20,465	$ 28,136
Discounted Profit	$ 29,000	$ 30,061	$ 22,739	$ 34,010	$ 18,980	$ 24,040	$ 31,559
Total Discounted Revenues	$ 134,874	$ 135,248	$ 132,966	$ 141,967	$ 127,355	$ 129,368	$ 138,801
Discounted Lost Resources	1,876	2,041	2,311	1,194	2,701	2,409	2,071
Total Discounted Production	3,733	3,567	3,297	4,415	2,907	3,199	3,537

Alternatives 7-12

Critera	Status Quo	Alt. 7	Alt. 8	Alt. 9	Alt.10	Alt. 11	Alt. 12
	Current Leasing System	Profit Share (30%) Royalty 18.75%	Profit Share (30%) No Royalty	Higher Area Rental Fee	Multi-Round Bidding	Work Commit-ment	Shorter Lease Term
Discounted Leasing Revenues	$ 81,333	$ 81,228	$ 63,320	$ 85,521	$ 77,382	$ 77,483	$ 78,005
Discounted Federal Taxes	$ 24,541	$ 17,042	$ 28,616	$ 22,281	$ 25,685	$ 20,054	$ 25,152
Discounted Profit	$ 29,000	$ 29,105	$ 41,108	$ 24,254	$ 28,626	$ 15,900	$ 32,876
Total Discounted Revenues	$ 134,874	$ 127,376	$ 133,044	$ 132,055	$ 131,694	$ 113,437	$ 136,033
Discounted Lost Resources	1,876	1,876	-	2,139	2,007	1,875	2,113
Total Discounted Production	3,733	3,733	5,609	3,469	3,601	3,734	3,495

Dollar Values are Expressed in Millions of 2003 Dollars

Slower Pace of Leasing

In general, slowing the pace of leasing is detrimental to Goal 1. Expeditious Development of OCS Resources. In terms of Goal 2, Obtain Fair Market Value, the model forecasts that slowing the pace of leasing results in larger cash bonus bids. However, other sources of revenue decline under a slower pace of leasing, including royalties, area rental payments, and federal corporate taxes. Thus, the effect on overall revenues is a complex interplay of several factors. Our model forecasts that overall federal revenues increase slightly (4.1%) with a return to the pace of leasing used prior to the advent of Areawide leasing. The reader should be cautioned, however, that this empirical result is dependent on extrapolating the number of tracts offered for sale far outside of the range of experience within the past 25 years. Given all of the many uncertainties, such small changes in forecasted revenues should be taken as an indication that offsetting effects are significant, and one should not expect a large overall change in revenues from slowing the pace of leasing.

We also find that a slower pace of leasing results in more competition for tracts (Goal 3), and the resultant reduction in OCS activity facilitates regional planning (Goal 5). But a slower place of leasing has offsetting effects on equitable sharing of costs and benefits (Goal 4) and is likely to adversely affect the maximization of overall social value associated with offshore production (Goal 6).

Changing Royalty Rates

Increasing royalty rates adversely affects the expeditious development of OCS resources (Goal 1), and has offsetting effects on OCS revenues (Goal 2). Our model forecasts that increasing the royalty rate has a very small, but positive overall effect of OCS revenues (2.4%), which results from multiple offsetting factors. Again, given the many uncertainties involved, this small a change in forecast revenues should be taken as an indicator that one cannot expect large changes in revenues from increasing the royalty rate.

A higher royalty rate decreases competition (Goal 3), as it reduces the number of bids per tract. Increased royalty rates have offsetting effects on equitable sharing (Goal 4), as higher royalty rates are forecast to significantly increase shared revenues with coastal states and reduce environmental and social costs. But these effects are offset by a decrease in onshore expenditures associated with reduced OCS activity. At the same time, this reduction in activity reduces regional planning costs and environmental risks (Goal 5). We find an increased royalty rate will likely have a net negative effect on the overall social value of offshore development (Goal 6), because higher royalties distort incentives by making otherwise socially valuable resources unprofitable to extract. This lowers production because there are fewer profitable fields and because high royalties cause early closure of fields which are profitable despite the higher royalty.

Higher Minimum Bid

A higher minimum bid is forecast to reduce expeditious development of OCS resources (Goal 1) and to decrease OCS revenues (Goal 2). Higher minimum bids reduce the number of tracts sold, and the resultant tracts that go unsold are disproportionately lower valued tracts. At the same

time, a higher minimum bid will increase federal revenues from tracts that sell at the higher minimum bid, and would otherwise have sold at a lower bid.

Rather surprisingly, our model predicts that increasing the minimum bid slightly increases profits and associated federal corporate tax payments. This counterintuitive result likely occurs because tracts not leased due to the increased minimum bid are, on average, forecast by the model to be unprofitable. This suggests that either firms are overly optimistic about marginal tracts, or the model underestimates the potential of greater-than-expected-successes from tracts that appear to be marginal tracts at the time of the lease sale. This remains an open question.

A higher minimum bid results in more bids per tract sold (Goal 3). However, this occurs because increasing the minimum bid results in some marginal tracts going unsold. These marginal tracts would otherwise be sold typically with only a single bid, at or near the minimum. Thus, while the average number of bids per tract increases with a higher minimum bid, this does not imply increased competition for the remaining tracts that sell at a price above the minimum bid.

Increasing minimum bids reduces OCS activities, thereby facilitating regional planning and reducing potential environmental risks (Goal 5), and is forecast to have mixed effects on social values (Goal 6). Again this conclusion either suggests that firms make errors in assessing marginal tracts, or the model underestimates the potential of tracts that appear marginal at the bidding stage.

Profit Share

Due to a total absence of experience with profit share in the past 25 years, and the modest experience in prior years, the model uses a theoretical implementation of profit shares, rather than an empirically-based approach. Theory suggests that profit shares do not distort incentives, since whatever action maximizes profit with no profit share, also maximizes net profit, after paying the share. Thus, adding a profit shares to the status quo policy with 18.75% royalty rate does not change OCS activity levels (Goal 1), royalties or area rental payments. Using a 30% profit share in lieu royalty payments results in higher levels of OCS activity (Goal 1), since removing royalty payments eliminates the associated distortions in incentives for production.

Profit shares reduce the value of tracts to firms, and therefore reduce both cash bonus bids and federal corporate tax payments. Overall, we find a small decrease in OCS revenues (Goal 2) when adding a profit share to the status quo policy, and a larger decrease in revenue when using profit share in lieu of royalties, due to the total elimination of royalty payments. Overall, our model finds that federal take is lower under both profit share approaches than under the status quo. Adding profit share to the 18.75% royalty slightly reduces the number of bids per tract (Goal 3), since in some cases bids on marginal tracts fall below the minimum bid. Using a profit share in lieu of a royalty payment increases competition by increasing the number of bids per tract.

Adding profit share to an 18.75% royalty has an overall positive effect on Equitable Sharing of Costs and Benefits (Goal 4). But using a 30% profit share in lieu of royalty payments has offsetting effects, reducing revenue sharing and increasing environmental and social costs, while

increasing onshore expenditures associated with increased OCS activity. Both profit share options are forecast to slightly reduce total discounted revenues (Goal 5).

Profit share approaches also have an important adverse effect on the Integrity of the Leasing Process (Goal 7). There are important practical problems attempting to implement a profit share approach, since it is difficult for the government agency to monitor profits by the firm. Profit share payments depend on accounting profits, and there is considerable flexibility for firms to allocate costs and revenues such that it can be difficult or impossible for the government to verify claims regarding the appropriate profit share payment. Indeed, past experience with profit shares has found considerable difficulties coming to agreement on profit share payments. In the mechanism design literature, these problems are referred to as imperfect monitoring.

Higher Area Rental Rates

Increasing area rental payments reduce the number of tracts sold, thereby reducing expeditious development of OCS resources (Goal 1). Increasing the area rental has mixed effects on federal revenues (Goal 2), decreasing bids and royalty payments, while increasing area rental payments. Overall, higher area rental rates are forecast to result in a small increase (1.8%) in federal revenues. This is not likely significant, given all of the uncertainties involved.

Increased area rental payments increase the number of bids per tract sold (Goal 3). However, similar to increasing minimum bids, increasing area rental payments reduces the marginal tracts that would otherwise be sold with only one bid, and thus increases the average number of bids per tract. However, this does not lead to any real increase in the competition for the remaining tracts. Increased area rentals has offsetting effects on equitable sharing of costs and benefits (Goal 4). This is because, increased area rentals increase revenues shared with coastal states and reduce environmental/social costs due to reduced activity. But at the same time, higher rental rates decrease onshore expenditures associated with offshore activity. Higher rental rates facilitate regional planning (Goal 5) due to the associated reduction in OCS activity.

Multi-Round Auctions

Multi-Round Auctions decrease most Criteria associated with expeditious and orderly development (Goal 1), except for the average annual number of tracts sold. Multi-round auctions lead to more overall tracts sold, and more tracts sold early, but fewer tracts sold later when prices are higher and technology improves. Multi-Round auctions also reduce overall revenues slightly (Goal 2). Area rental payments increase significantly due to increased numbers of tracts sold, but otherwise discounted OCS revenues decline. the Federal tax revenues increase, primarily because of lower cash bonus bids under multi-round auctions, which are otherwise written off for tax purposes.

Multi-round auctions lead to fewer bids per tract (Goal 3) as more marginal tracts are bid upon and sold, and these tracts receive few bids. Thus, while there are more bids overall, there are more tracts sold, and as a consequence fewer bids per tract sold. Revenue sharing with coastal states and onshore expenditures both decrease with multi-round auctions, but this is offset by environmental and social costs, which also decrease slightly (Goal 4).

Multi-round auctions considerably increase the number of tracts sold, thereby contributing to increased regional planning costs, but reduce other measures of planning costs and environmental risks (Goal 5). Multi-round auctions lead to an overall decrease in social value (Goal 6).

Work Commitment

Work commitment has offsetting effects on expeditious and orderly development of OCS resources (Goal 1). Work commitment increases exploratory activities on each tract sold, but the commitment to higher exploration activity decreases the number of tracts that appear profitable, and therefore reduces the number of tracts sold. The number of exploration wells increases significantly, and a small number of additional fields are discovered, but many of those fields are small fields that would not be found with a smaller level of effort, and are only marginally productive.

Work commitment decreases measures of obtaining fair market value (Goal 2), as cash bonus bids are reduced slightly, royalty payments increase, but area rental payments decline considerably due to fewer tracts sold. Overall, our model forecasts that revenues decline by about 8% with a work commitment policy. Bids per tract sold increase, but again this occurs because marginal tracts go unsold that would otherwise receive only one bid. This does not result in a real increase in competition for tracts that continue to be sold despite the work commitment.

Work commitment has offsetting effects on regional planning (Goal 5) by significantly decreasing the number tracts sold, while increasing the number of fields discovered and having only very small effects on other Criteria. But work commitment has a negative effect on maximizing social value (Goal 6) by decreasing all sources of revenues, while having a small positive, but insignificant, overall effect on lost resources.

Shorter Lease Term

Shorter lease terms have negative effects on most measures of expediting development of OCS resources (Goal 1). The model forecasts that more tracts are sold, but this occurs because fewer fields are found due to the shorter lease period, and therefore there is less resource depletion. In effect, shorter lease terms reduce the effectiveness of exploration of tracts, such fields go undiscovered during exploration, and the associated tracts are resold in the future. By the same token, a shorter lease period is forecast to increase area rental payments, but is otherwise forecast to reduce revenues associated with OCS leasing (Goal 2) and reduce competition for tracts (Goal 3). Shorter lease terms slightly reduce revenue sharing, and significantly reduce state revenues associated with onshore expenditures, but reduce environmental and social costs (Goal 4). The model concludes that by most measures, regional planning (Goal 5) is facilitated by shorter lease terms, except that more tracts are sold, which might partially offset what would otherwise be reduced planning costs. Shorter lease periods are forecast to reduce most measures of overall social welfare (Goal 6).

IV. Areawide OCS Leasing and Leasing in State Waters

We also explore the extent to which Areawide leasing in the federal waters of the GOM could potentially harm coastal states by reducing industry interest in, and revenues from, sales in state offshore waters by "flooding the market" with leases. Carrying out a thorough analysis of this issue would require an extensive study in its own right, and is beyond the scope of the present effort. Rather, we briefly review some readily available data to provide a perspective on the issue.

The effect of Areawide leasing in federal waters on State leasing revenues is dependent upon the extent to which tracts in state waters are close substitutes for tracts in federal waters. While the products are the same – oil and gas – available evidence suggests that leases in federal waters may not be close substitutes for leases in state waters. Our discussion uses Louisiana as an example. Section II of the Technical Report presents additional details.

Louisiana State waters are mature oil and gas areas, which have been well explored and developed over many decades. The mature stage of production in offshore Louisiana is reflected by the steady decline in the production in state waters since reaching its peak in 1970 (http://dnr.louisiana.gov/sec/execdiv/techasmt/facts_figures/table04.htm). By 1983, offshore production in State of Louisiana offshore waters was reduced to about 1/3 of peak production, and by 2008 production was reduced to about 8% of peak production. Since discoveries of new resources considerably lead production, the peak in new discoveries in state waters must have begun its decline even earlier, although we have not identified nor analyzed detailed data as part of this study. Nevertheless, production in State of Louisiana waters has been in decline for nearly 40 years.

Thus, production from offshore LA began to decline well before Areawide leasing was introduced. Nearshore OCS lands also have been well explored, with the vast share of OCS activity now occurring in deep water, far from shore (Iledare, et al., 2004). And this trend is virtually certain to continue into the future.

Deep water oil and gas operations are highly sophisticated and rely on drill ships and semi-submersibles and accurate positioning, subsea completions, and operating in deep and risky waters far from shore. In short, technologies and equipment used for deepwater operations differ enormously from those in state waters. Transferability of equipment, technology and skilled personnel between nearshore and deepwater offshore areas is likely to be very limited.

Lastly, support for the notion that OCS oil and gas operations in Louisiana state waters are not close substitutes is the fact that different companies are involved in each area, and OCS operators show relatively low intensity in bidding for State of Louisiana tracts. We explored the issue of substitutability and intensity of interest by reviewing oil and gas companies' overlapping bids. These are cases where companies that bid on OCS tracts also bid on State of Louisiana offshore tracts (in Louisiana, "parcels").

We obtained from Minerals Management Service a list of companies that bid in federal offshore lease sales. According to the data obtained from MMS, 531 companies bid on OCS tracts from 1980 to 2008 inclusive. Turning to the State of Louisiana, our list of companies that participated

in sales of offshore tracts came from sales data. Louisiana holds monthly oil and gas lease sales. We adopted a "convenience sample" for Louisiana whereby we considered all sales of parcels for every other monthly sale for the years 2003, 2005, 2007 and 2008, the last year for which data could be obtained. The sources we used and summary data are given in Table II-3 of the Technical Report.

On a company basis, of the 531 companies that bid on OCS tracts over the period 1980 – 2008, 35 (6.59%) also bid on the sample of Louisiana offshore parcels included in our convenience sample. The 35 companies that bid on both OCS and State of Louisiana offshore tracts are 13.83% of the 253 companies that bid on offshore State of Louisiana parcels. Firms that bid on OCS tracts apparently have only a modest interest in State of Louisiana offshore tracts, while firms that bid on Louisiana offshore tracts have a greater – but still relatively modest – interest in OCS tracts[1].

Looking instead at the number of bids, the 35 companies which bid on Louisiana offshore parcels and OCS tracts submitted 101 bids on Louisiana offshore lands. This is about 9% of the 1,117 bids in the State of Louisiana lease sales included in our convenience sample. This suggests that firms which bid in both Federal and State waters were relatively unaggressive in bidding for tracts in Louisiana offshore areas.

In summary, while we have not been able to carry out a thorough study of the issue, available evidence suggests that Federal and State offshore tracts are not close substitutes for each other. So one would expect that leasing policies in Federal waters would likely have relatively modest effects on leasing revenues in State offshore waters. While we recognize offshore revenues remain important for the State of Louisiana, production in State waters has been in steady decline for nearly 40 years. Any adverse effect of Areawide on state leasing revenues would likely be offset, in whole or in part, by the associated increase in onshore expenditures that support offshore activities in the Federal waters (e.g., Dismukes et al, 2003).

Together, this suggests that one would not expect that a policy of Areawide leasing in Federal OCS waters to have a large adverse effect on future revenues in Louisiana. More detailed discussion of this issue is presented in Section II of the Technical Report.

[1] It is possible that offshore companies have subdivisons with different names which work onshore (or vice-versa) or that incorrect spelling of company names in electronic lists masks companies which operate in both offshore areas.

V. Summary and Conclusions

This summary report describes an extensive study to assess alternative policies for leasing OCS oil and gas resources in the Central and Western Gulf of Mexico. The study employs a simulation model to forecast the pace of leasing, and associated OCS activities, revenues and other impacts over a 50-year time horizon for lease sales. Alternative policies are compared to the status quo policy of Areawide leasing. The comparison is formulated in terms of the extent to which each policy can fulfill a set of policy Goals for OCS development.

This analysis finds that no single leasing policy alternative promises to outperform all other policies in terms of every Criteria. In particular, no policy outperforms the status quo policy of Areawide leasing in terms of all Goals. Rather, a policy that performs better at some policy Goals, is less effective at others. Hence, the choice among policy alternatives necessarily involves making tradeoffs across the various Goals of the OCS leasing process.

Furthermore, even considering an alternative that is more effective at achieving a particular Criteria, there tends to be offsetting effects such that differences across alternatives are moderated, and are smaller than one might initially expect. For example, our model finds that greatly slowing the pace of leasing is expected to significantly increase cash bonus bids. But this is likely to be offset, in whole or in part, by subsequent delays and/or reductions in other payments such as royalty payments, area rentals and federal corporate taxes. A slower pace of leasing also adversely affects our ability to achieve some policy Goals (e.g., expeditious development of OCS resources), while benefiting others (e.g., facilitating regional planning).

Similarly, our analysis finds that higher royalty rates can increase royalty payments, but at the cost of lower cash bonus bids, area rental payments and federal corporate tax payments. The analysis finds that financial gains from changes in royalty payments may be possible, but it is unlikely that large increases in overall revenues will result because of these various offsetting effects. Given the many uncertainties involved, and the absence of recent experience with higher royalty rates, one cannot conclude with confidence whether overall federal take will increase or decrease with higher royalty rates. But the model suggests that substantial gains seem unlikely. And increasing royalty rates also come at a cost of less expedited resource development, and losses in social welfare due to the distortions in incentives, such that socially valuable resources are left in the ground.

One larger lesson of this analysis is that, while the "revenue equivalence theorem"[2] does not strictly apply to OCS leasing, there is a tendency towards equalization of revenues of the different policies that we consider. For example, increasing one or more of the fees will adversely affect tract values, so that the increase in the fees, in effect, becomes capitalized into the values of tracts. So increases in one fee will tend to be offset, in whole or in part, by reductions in cash bonus bids.

[2] The Revenue Equivalence Theorem is a well known result from auction theory, which roughly speaking says that under certain highly restrictive conditions, one can expect identical revenues from all "standard" auction designs (see, for example, Milgrom, 2004). Therefore, under these conditions, the specific form of the auction has no effect on the outcome. This theorem is discussed in more detail in the Section IV of the Technical Report.

Tradeoffs are inevitable when comparing policy alternatives, and a thoughtful analysis of the full effects of various policies suggests that we need to have realistic expectations of possible gains from a particular option. This does not imply that no potential gains are possible from changing policies, but rather that offsetting effects imply that any gains that might occur will likely be modest, and will be difficult to forecast with confidence given the long time horizons involved and the many uncertainties.

Although our approach has examined incremental effects of individual policy changes on Goals, the results can also provide insight into combinations of policies that are most effective in attaining specific Goals, while recognizing the inevitable tradeoffs that result. For example, achieving the Expeditious and Orderly Development of OCS Resources (Goal 1) could be enhanced by combining policies, such as a lower royalty rate and a fast pace of leasing. Or if one wanted to Facilitate Regional Planning and Reduce Environmental Risk (Goal 5), this Goal could be better achieved by reducing the pace of leasing while increasing the royalty rate. As noted earlier, the effects of policies are not likely to be simply additive, and interaction effects are likely difficult to ascertain with confidence, given the many uncertainties and the long time horizon involved. But at the same time, policies are likely to have cumulative effects, so that if both policies are used together, there would likely be a larger effect on production than if either policy is used alone.

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