Chapter Five

CONCLUSIONS

This report presents a methodology to enhance the regional assessment of gas and oil resources for the purposes of strategic (long-term and large-scale) planning of energy resource development on public lands. We apply the methodology to a case study of the Greater Green River Basin in southwestern Wyoming. However, the approach developed here is intended to be applicable to other areas of the Rocky Mountains as well as other regions of the nation.

The purpose of gas and oil resource assessments is to provide decisionmakers with a scientifically informed estimate of the quantity and spatial extent of the resource. In standard practice, the assessment is based on a measure called the "technically recoverable resource," which is the resource accessible according to some definition of technological capability.

In the methodology presented in this report, we develop additional criteria related to the economic costs of production and transport and measures of environmental concern. We then overlay these criteria on the base estimate of technically recoverable resource to provide a more complete view of the amount of resource that could potentially be developed under various cost assumptions. The information produced can help federal and state land managers and policymakers at all levels set priorities and strategically plan for long-term resource use.

BENEFITS

This methodology offers several supplementary benefits to decisionmakers over the traditional resource assessment:

- Allocating resources to subplays and distinguishing between separate resource categories allows stakeholders to envision the intra-basin spatial distribution of resources.
- Including economic criteria enables federal land managers and other decisionmakers to consider relative priorities for land use based on economic viability of the resource.
- Overlaying the distribution of resources under various economic assumptions with distributions of land characteristics reflecting potential environmental concerns provides a more complete view of actual environmental assets—distinct

from legal access restrictions—coincident with areas of potential resource development.

- The methodology can be adapted to become an interactive decisionmaking tool, in which modeling and planning assumptions can be varied and their effect on resource estimates examined.
- The methodology offers an additional tool for energy forecasters to provide further spatial and temporal refinements to their long-term resource estimates.

LIMITATIONS

The methodology also has limitations that should be kept in mind when interpreting results.

- Scale and resolution make this method suitable for broad-scale assessment and planning purposes but not for specific local scale analyses of resource potential or environmental impacts.
- The production cost functions, spatial distribution of resources, and overlay results are predicated on several simplifying assumptions. The sensitivity of results to these assumptions is an important consideration in interpreting the results.
- The economic results represent current estimates and will evolve with time. Long lead times for planning based on short-term estimates of economics should be accounted for in the planning process through the use of bounding scenarios.
- Uncertainty in the effect of gas or oil development on environmental measures means that these overlays should be used to signal the need for further study and analysis of likely impacts and opportunities for mitigation.

In addition, this method produces information that supplements other sources of information about the resource and should not be used in isolation. It is not designed nor should it be used to replace detailed economic analyses of resource potential on specific leases or NEPA-like environmental analyses.

INTERPRETATION OF GREEN RIVER BASIN RESULTS

The case study illustrates the use of the methodology to assess natural gas resources in the Greater Green River Basin. These results are instructive for developing the methodology further and providing insights that may help inform strategic energy resource planning in this basin. Results are summarized in Table 5.1.

Depending on the economic scenario, 35 to 45 percent of the natural gas resources could be produced profitably at a market price of $3/MMBtu, which is similar to recent prices in Wyoming. Up to 65 percent could be profitably produced if the market price were $5/MMBtu. If electric utilities or state energy planners had this information available for all basins in the region, they could better plan their long-term resource use by having a more realistic view of availability based on production costs.

Table 5.1

Summary of Results

	Cost ($/MMBtu)	
	3	5
Economically recoverable gas Tcf:	47–68	70–104
% of TRR:	35–45	52–65
Percentage of economically recoverable gas on lands		
With high terrestrial vertebrate species richness[a]	17	17
Within 2,000 m of sensitive species locations	14	14
Within 6,500 m of sensitive species locations	65	65
With surface water, wetlands, or riparian habitats	9	10
Near human settlements	5	6
With high surface slope[b]	8	8
With high aquifer recharge rate[c]	9	9
With shallow groundwater[d]	9	10
Subject to no access[e]	10	10
Subject to restricted access[e]	31	30

NOTES: Ranges for economically recoverable gas reflect different economic scenarios. Results for environmental measures are for the USGS-based scenario only; percentages shown do not necessarily apply to separate areas and so are not additive.

[a]>119 species/area.

[b]>25%.

[c]>2 inches/year.

[d]<16 feet.

[e]Results are based on aggregated lease stipulations from Advanced Resources International, Inc. (2001) and are not related to environmental measures analyzed in this study.

Likewise, the Energy Information Administration could use this more detailed information in its price and supply forecasts.

When examined in terms of spatial context, our economic analysis provides further insight. The spatial analysis shows that the distribution of technically recoverable gas throughout the basin is uneven, with higher gas concentrations in the western and central areas of the basin (Map 2.2). When considering economically recoverable gas, the spatial distribution is broadly similar to that of the technically recoverable gas and the concentrations vary relatively smoothly with cost on the basinwide scale (see maps). In detail, however, concentrations in some areas drop off much more quickly than in others as the price decreases. Thus, the fraction of gas that is economically recoverable at a given price varies substantially from place to place. For example, at $3/MMBtu, the ratio of economically to technically recoverable gas in particular areas is far smaller than the basinwide value of 35 to 45 percent. This is most apparent for portions of the Great Divide and Washakie Basins, where this ratio is lower than 1 percent (see Maps 2.2 and 3.1). In other places, the ratio of economically to technically recoverable gas exceeds the basinwide average and can approach one. These results illustrate the value of the combination of economic and spatial analyses: Concentrations of economically recoverable resources do not necessarily correlate directly with the concentrations of technically recoverable resource. By using transparent economic and other quantitative criteria, the methodology enables decisionmakers to establish a credible basis for more spatially refined priorities for access and permitting.

The environmental measures analysis provides additional understanding of the gas resource in the Greater Green River Basin. A useful way to consider these results is in terms of the relative proportion of gas resources at any cost on lands having different values of environmental measures. These results are presented in Table 5.1. Our analysis indicates that these proportions are nearly independent of economic considerations—the overlay results for gas distributions at different costs differ by less than 5 percent.

For the most part, the concentrations of economically recoverable gas are in areas having values of environmental measures of relatively lesser concern. As with the economic evaluation, however, environmental overlay results for certain areas within the basin differ from the basinwide average values shown in Table 5.1. A few areas, such as north of the LaBarge Platform and parts of the Great Divide Basin, have relatively high gas densities that coincide with riparian habitats, high terrestrial vertebrate species richness, and shallow groundwater. Such insights may be particularly useful in areas, such as north of the LaBarge Platform, that may appear quite promising judging by the economic analysis alone.

The connection between environmental measures and likelihood of environmental impact is complex, and actual environmental impacts would not necessarily result from development on lands with individual measures above (or below) a specified level of concern. However, our results suggest that these lands might be less attractive than other lands for development. For example, there may be more costs associated with mitigating potential impacts on lands close to surface water resources. This information would be useful to public land managers who may need to prioritize their efforts in permitting lands for exploration and production.

The results generated from this approach can provide decisionmakers with more robust information about natural resources that can help guide strategic resource planning, help prioritize difficult decisions that are being made about access to federal lands, and help understand the potential consequences of decisions.

IMPLICATIONS FOR THE ROCKIES

The primary objective of this study was to develop a methodology that incorporates economic (including development, production, and infrastructure) and environmental considerations into energy resource assessments. The methodology was developed with a focus on the Greater Green River Basin because of its overall high resource potential and its diverse range of deposit types and depths, which results in a large range of development and production costs. In doing so, we have highlighted some aspects of natural gas resources in the Greater Green River Basin that may not be directly evident from technically recoverable resource assessments. However, the value of this approach is expected to be even more evident when it has been applied to all the basins in the Rocky Mountains and eventually to all basins in the country. Just as a basinwide evaluation using a consistent methodology allows federal land managers to compare and prioritize areas within the Greater Green River Basin, a Rockies-wide evaluation will allow these managers to make the same type of comparisons and prioritizations among areas within different basins.

Given the continuing increase in demand for natural gas and the practical limitations on meeting this demand by increasing imports, gas production in the United States is expected to increase substantially in the coming years. Industry and government are looking to resources in the Rocky Mountain region, the majority of which underlie federal land, to generate much of this supply. Federal land managers are thus facing demands for substantial increases in the amount of natural gas production in the Rockies. Efforts are already under way to expedite the approval process of energy-related developments on federal lands (U.S. Bureau of Land Management, 2001). It is therefore increasingly important that attention be paid to strategic land use planning.

ISSUES FOR FURTHER DEVELOPMENT

The methodology proposed in this work represents a first step toward the goal of expanding the scope of energy resource assessments to help improve decisionmaking. The approach represents a substantial change in the way resource assessments are conducted as well as in how they may be used to inform policy. As such, it is preliminary in several aspects and will require continued development to improve its utility. Further development should focus on several areas:

Develop Environmental Measures

The environmental measures proposed here represent a first-order attempt to provide a framework to characterize energy resources in terms of the potential environmental impacts associated with their development. To be more effective, further research must be conducted to address three general limitations. More discussion of these limitations is included in Chapter Four.

- Refine the selection of measures to cover the relevant range of potential environmental impacts associated with gas and oil development. Examples not addressed in this report include measures to capture regional air quality and cumulative impacts over time and space.
- Refine the relationship between the measure values and potential impacts. The current approach uses primarily a statistical analysis to assess relative concern within the study area. An empirical approach based on an understanding of environmental impacts and gas and oil activities would improve the method.
- Develop a scientifically informed means to combine the information from multiple measures, through either integrating or ranking. A combined measure would be more manageable in terms of understanding environmental considerations of different resources.

Addressing each of these points will require consultations with public land managers about their information needs; consultations with landowners, producers, leaseholders, and environmental and other conservation interests; and research and recommendations from the scientific community. The unifying objective would be to

apply relevant information and knowledge to a systematic approach that can be used at a regional planning scale.

Refine the Appropriate Scale of Applicability

The objective of our approach is to conduct an assessment at the basin scale to help guide decisions regarding subbasin scale areas. The data used for the economic and environmental evaluations come from a number of sources having differing resolutions and accuracies. This raises the question of the scale at which it is appropriate to draw conclusions about different areas within the basin. As discussed in Chapter Three, resolution of about 30 miles may be meaningful for the economic analysis. However, this resolution may not be compatible with the resolution of the environmental data. It also does not consider the effect of several uncertainties, including the allocation of resources to subplays. A better understanding of the relevant scale for decisionmaking is needed to guide the implementation of this approach. Improved data acquisition with more consistency in scaling may improve estimates of the resolution associated with the outputs of the proposed method.

Better Incorporate the Methodology into Decisionmaking

In proposing our approach, we have outlined particular ways the information can be used to inform policy in the decisionmaking process. However, we recognize that aspects of the methodology may need to be modified to best meet the objectives of the decisionmaking process. For example, there is currently no precedent for interpreting economically recoverable resources. One possibility is to link them to Energy Information Administration price projections. Another question is how to integrate the environmental measures with the existing environmental analysis processes, including NEPA and designation of lease-specific access restrictions.

The methodology presented in this study provides a more complete understanding of energy resource characteristics by accounting for the economics, or real dollar costs, associated with production and moving some of the environmental protection considerations, or social costs, upstream in the decisionmaking process. In the process, it is meant to help define the potential for productivity and the anticipated environmental considerations of gas and oil resources. Such information is intended to help guide government officials and other stakeholders in land use planning, development of energy policies, and energy development and utilization planning.