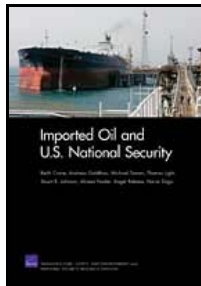




# Highlights of Recent RAND Research on Energy & Environment

*For more information, contact Shirley Ruhe, Director of Office of Congressional Relations, at 703-413-1100, x5632 or Jennifer Warren, Energy and Environment Legislative Analyst at x5938.*

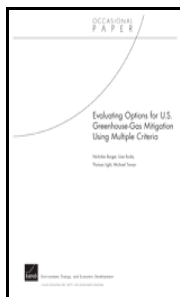
The RAND Corporation has been conducting research for federal, state, nonprofit, and private-sector entities on the interrelated issues of the environment, natural resources, energy, and economic development since the 1960s. Today's research addresses a range of topics of relevance to U.S. and international audiences, including environmental quality and regulation, energy resources and systems, water resources and systems, climate change, and natural hazards and disasters.



## **Imported Oil and U.S. National Security**

Keith Crane et al., 2009

In 2007, on a net basis, the United States imported 58 percent of the oil it consumed. This book critically evaluates commonly suggested links between these oil imports and U.S. national security. The major risk to the United States posed by reliance on oil is the economic costs of a major disruption in global oil supplies. On the other hand, the study found no evidence that oil exporters have been able to use embargoes or threats of embargoes to achieve key political and foreign policy goals. Oil revenues are irrelevant for terrorist groups' ability to launch attacks. The study also assesses the economic, political, and military costs and benefits of potential policies to alleviate challenges to U.S. national security linked to imported oil. Of these measures, the adoption of the following energy policies by the U.S. government would most effectively reduce the costs to U.S. national security of importing oil: (1) Support well-functioning oil markets and refrain from imposing price controls or rationing during times of severe disruptions in supply. (2) Initiate a high-level review of prohibitions on exploring and developing new oil fields in restricted areas in order to provide policymakers and stakeholders with up-to-date and unbiased information on both economic benefits and environmental risks from relaxing those restrictions. (3) Ensure that licensing and permitting procedures and environmental standards for developing and producing oil and oil substitutes are clear, efficient, balanced in addressing both costs and benefits, and transparent. (4) Impose an excise tax on oil to increase fuel economy and soften growth in demand for oil. (5) Provide more U.S. government funding for research on improving the efficiency with which the U.S. economy uses oil and competing forms of energy.



## **Evaluating Options for U.S. Greenhouse-Gas Mitigation Using Multiple Criteria**

Nicholas Burger et al., 2009

Choosing a set of policy responses to mitigate greenhouse gases (GHGs) responsible for climate change is one of the great challenges that the United States faces in the coming years. Many policy options emphasize overall cost-effectiveness in reducing GHG emissions. In the search for options that are effective and politically feasible, however, other concerns have comparable importance. Mitigating GHGs in practice will require balancing cost-effectiveness and other objectives that reflect the institutional and political realities of passing major federal legislation with widespread impacts on U.S. producers and consumers. This paper develops a framework for evaluating GHG-mitigation policy in the United States that balances several criteria. It draws on conceptual analysis and examples from U.S. energy policy to motivate an evaluative framework that incorporates a range of views of what constitutes “good” policy. It should be of interest to stakeholders in the GHG policymaking process and especially to those responsible for crafting U.S. climate policy.

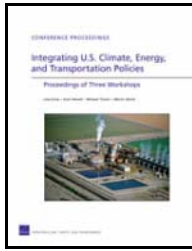


## **The Global Technology Revolution China, In-Depth Analyses**

### **Emerging Technology Opportunities for the Tianjin Binhai New Area (TBNA) and the Tianjin Economic-Technological Development Area (TEDA)**

Richard Silbergliitt et al., 2009

In 2007, the Tianjin Binhai New Area (TBNA) and one of its administrative zones, the Tianjin Economic-Technological Development Area (TEDA), in northeast China commissioned the RAND Corporation to perform a technology-foresight study to help them develop and implement a strategic vision and plan for economic growth through technological innovation. The principal objectives were to identify the most-promising emerging technology applications for TBNA and TEDA to pursue as part of their plan for growth, to analyze the drivers and barriers they would face in each case, and to recommend action plans for each technology application (TA). Seven TAs should form a pivotal part of TBNA's comprehensive strategic plan: cheap solar energy; advanced mobile communications and radio-frequency identification; rapid bioassays; membranes, filters, and catalysts for water purification; molecular-scale drug design, development, and delivery; electric and hybrid vehicles; and green manufacturing. The specific action plans can be integrated into an overarching strategic plan that rests on three legs: building a state-of-the-art R&D program; updating and expanding TBNA and TEDA's manufacturing base; and positioning TBNA and TEDA for the global marketplace. The plan offers TBNA a wealth of opportunities that will position it for the future development it envisions, and each TA emerges from one or more of TEDA's current pillar industries, making for a fluid transition that builds on existing strengths.



## **Integrating U.S. Climate, Energy, and Transportation Policies**

### **Proceedings of Three Workshops**

Liisa Ecola et al., 2009

In June 2008, the RAND Corporation convened three workshops on policies for mitigating climate change. These workshops brought together representatives of government, industry, advocacy groups, and the research community who hold different perspectives on what the goals of climate change mitigation policy should be and which strategies should be implemented to achieve them. The workshop series was made possible by a generous grant from the McCormick Foundation. Addressing the interconnection of climate change mitigation policy with the key sectors of energy and transportation will be major challenges for the United States in the coming years. The competing interests of these groups sometimes hamper progress on this front. Bringing them together enabled them to share different perspectives and to identify some common points of view on such issues as technological innovation; federal, state, and local roles; potential legislative and regulatory solutions; international cooperation; and public engagement. These RAND conference proceedings summarize key issues and discussion topics of the three workshops. This document is not intended to be a transcript of the discussions and does not quote any participants by name or affiliation. Rather, it organizes the key themes of the workshops by topic — in particular, pointing out areas of agreement as well as disagreement.



## **Research Priorities for Fossil Fuels**

James T. Bartis, 2009

Testimony presented before the Senate Energy and Natural Resources Committee on March 5, 2009.



## **Alternative Fossil-Based Transportation Fuels**

### **Economic Benefits and Environmental Concerns**

Michael Toman et al., 2008

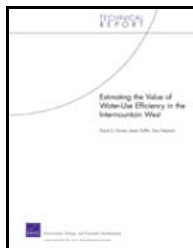
Alternative fuels derived from oil sands and from coal liquefaction can cost-effectively diversify fuel supplies, but neither type significantly reduces U.S. carbon-dioxide emissions enough to arrest long-term climate change.



## **Balancing Environment and Development Costs, Revenues, and Benefits of the Western Riverside County Multiple Species Habitat Conservation Plan**

Lloyd Dixon et al., 2008

The Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) is an ambitious effort to balance development and environmental concerns in an area of rapid urban growth. In return for setting up a 500,000-acre conservation reserve, the U.S. Fish and Wildlife Service and the California Department of Fish and Game granted the county and cities in western Riverside County a 75-year “take” permit for endangered species. The take permit allows the cities and county to approve development projects outside the reserve that could negatively affect 146 sensitive plant and animal species. The plan is supposed to speed the frequently time-consuming and litigious process of permitting new highway and development projects while establishing an integrated conservation reserve rather than the patchwork of uncoordinated reserves that was so often the case in the past. The Western Riverside County Regional Conservation Authority (RCA) acquires land for and manages the reserve. This monograph examines the value of the land needed for the reserve, the financial consequences of acquiring the land over different periods of time, and the projected costs of operating the reserve. It compares projected costs and revenues and identifies potential funding sources to fill any resulting funding gap. It also examines the prospect for achieving the MSHCP's habitat-conservation goals and whether the MSHCP has, in fact, streamlined the permitting processes. Finally, it identifies issues that the RCA Board of Directors, RCA staff, and stakeholders should address to ensure the plan's success and the ongoing economic and ecological health of the county.



## **Estimating the Value of Water-Use Efficiency in the Intermountain West**

David G. Groves et al., 2008

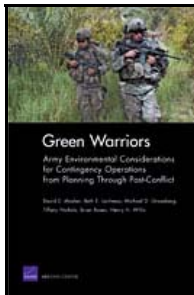
Evaluating the cost-effectiveness of water-efficiency programs can be difficult, because not all the benefits are easily quantified. This report presents an economic framework based on two tools from the California Urban Water Conservation Council to estimate the avoided costs and environmental benefits of an agency's efficiency programs. The report evaluates the benefits of Denver Water efficiency programs and uses an exploratory modeling approach to accommodate the significant uncertainty in such estimations. The results of this study suggest that the inclusion of long-run avoided costs and environmental benefits is critical to fully recognizing the value of water-use efficiency programs. The authors find that evaluating only the short-run avoided costs leads to the conclusion that many water-efficiency projects already a part of Denver Water's 10-year conservation plan are not cost-effective. When long-run avoided costs and environmental and recreational benefits were factored in, all but two Denver Water programs were estimated to be cost-effective. The timing of projected water savings from efficiency programs is also critical. Water savings from programs that concentrate savings during summer months, when water is scarcer, should be valued higher than saving from programs that lead to more uniform water savings throughout the year, because these water savings reduce peak water needs.



## **Federal Financial Incentives to Induce Early Experience Producing Unconventional Liquid Fuels**

Frank Camm, James T. Bartis, and Charles J. Bushman, 2008

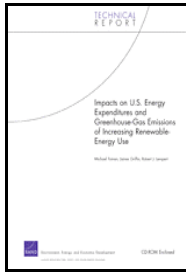
The government, as a principal, may seek to induce a private investor, as an agent, to build and operate an unconventional-oil production plant to promote early production experience with such plants. Given this goal, facing significant uncertainty about the future, the government wants to limit the cost to the public treasury of doing this. This report offers an analytic way to design and assess packages of policy instruments that the government can use to achieve its goal. It starts with general principles of the economic theories of contracting and agency. Looking across many alternative futures helps the authors design incentive packages that are robust from a private perspective and limit costs to the government. As these principles would predict, cash-flow analysis demonstrates the cost-effectiveness of using investment incentives rather operating incentives and the powerful effect that a higher debt share has on the private rate of return. Cash-flow analysis also reveals specific opportunities that the government has to change course among policy alternatives as it seeks the lowest-cost way to increase the private rate of return associated with a project.



## **Green Warriors Army Environmental Considerations for Contingency Operations from Planning Through Post-Conflict**

David E. Mosher et al., 2008

Recent experiences in Iraq, Afghanistan, and the Balkans have highlighted the importance of environmental considerations. These range from protecting soldier health and disposing of hazardous waste to building water supply systems and other activities that help achieve national goals in the post-conflict phase of contingency operations. The Army has become increasingly involved with environmental issues in every contingency operation and must be better prepared to deal with them. This study assesses whether existing policy, doctrine, and guidance adequately address environmental activities in post-conflict military operations and reconstruction. Findings are based on reviews of top-level policy and doctrine, analysis of operational experience, extensive interviews with diverse Army personnel, and a review of operational documentation and literature. From these sources, a database of 111 case studies was created. The research showed that environmental concerns can have far-reaching and significant impacts on the Army, both direct and indirect, especially in terms of cost, current operations, soldier health, diplomatic relations, reconstruction activities, and the ultimate success of the operation or the broader mission. Some evidence suggests that environmental problems may have even contributed to insurgency in Iraq. Recommendations include updating current policy and doctrine to fully address environmental considerations in contingency operations; ensuring that contractors are carefully selected and managed; and transmitting proactive field environmental practices and lessons throughout the Army.



## Impacts on U.S. Energy Expenditures and Greenhouse-Gas Emissions of Increasing Renewable-Energy Use

Michael Toman et al., 2008

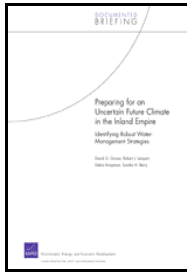
The penetration of renewable energy into the marketplace has been small, held back principally by their higher cost relative to fossil energy. RAND assessed the potential impacts on U.S. consumer energy expenditures and national CO<sub>2</sub> emissions of producing 25 percent of U.S. electric power and motor-vehicle transportation fuels from renewable resources by the year 2025. The baseline for the comparisons was expenditures and CO<sub>2</sub> emissions in 2025 as drawn from the reference-case tables of the Energy Information Administration's 2006 *Annual Energy Outlook*. The report shows that increasing renewables use can reduce CO<sub>2</sub> emissions and enhance energy security by lowering the cost of imported petroleum. However, a large, inexpensive, easily converted biomass supply is necessary for significantly increased renewable-energy use to have a relatively low impact on consumer energy expenditures. Rapid progress also is needed in the technologies converting biomass feedstock into transportation fuels, and producing power at marginal wind sites. Without progress in these areas, the renewable-energy requirement could substantially increase consumer energy expenditures. Technical advances in provision of economically and environmentally sound biomass energy and wind power generation at lower-quality sites should be top priorities for increasing affordable supplies of renewable energy. The report replaces an earlier version withdrawn in 2006 to correct errors in modeling discovered by RAND post-publication.



## Policy Insight, Volume 2, Issue 2, April 2008 New Engines and Fuels for Cars and Light Trucks

Ryan Keefe et al., 2008

Rising oil prices and concerns about energy security and climate change are pressuring automakers to produce vehicles with better fuel economy and reduced greenhouse-gas emissions. This *Policy Insight* discusses four innovations to fuel and engine technology that automakers will be developing over the next decade: gasoline-electric hybrid technology, advanced diesel technology, vehicles powered by a blend of ethanol and gasoline, and improvements to the traditional gasoline engine. Keefe, Griffin, and Graham highlight the advantages and disadvantages of each, drawing on a benefit-cost analysis in which they calculate the value of the three alternative technologies from a societal perspective, taking into account technology costs, fuel savings, performance benefits, pollution estimates, reductions in oil use, the cost of greenhouse-gas emissions, and other factors. They conclude that advanced diesels and gasoline-electric hybrids have a promising future but that policymakers appear to be favoring ethanol-fueled vehicles through a variety of regulations and tax subsidies.



## **Preparing for an Uncertain Future Climate in the Inland Empire Identifying Robust Water-Management Strategies**

David G. Groves et al., 2008

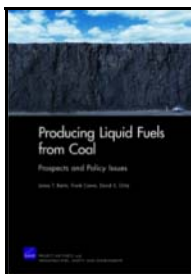
Water managers face significant uncertainties about future water-management conditions, including precipitation and temperature patterns that may be changing in response to global climate change. As part of a multiyear study on climate-change decisionmaking under uncertainty, RAND researchers are working with water agencies in California to help them better understand how climate change might affect their systems and what actions, if any, they should take to address this challenge. This briefing augments a recent RAND report, *Presenting Uncertainty About Climate Change to Water-Resource Managers: A Summary of Workshops with the Inland Empire Utilities Agency*, and describes the last of four workshops held with the Inland Empire Utilities Agency in Southern California. In this briefing, the RAND team presents an analysis, based on robust decisionmaking methods, of how different adaptive water-management strategies may reduce the vulnerability of the region to climate change and other planning uncertainties.



## **Presenting Uncertainty About Climate Change to Water-Resource Managers A Summary of Workshops with the Inland Empire Utilities Agency**

David G. Groves et al., 2008

Water-resource managers have long strived to meet their goals of system reliability and environmental protection in the face of many uncertainties, including demographic and economic forecasts, intrinsic weather variability, and short-term climate change induced by El Niño and other naturally occurring cycles. Now water managers also face a new uncertainty — the potential for longer-term and more persistent climate change, which, in coming years, may significantly affect the availability of supply and patterns of water demand. Information about the future effects of climate change is deeply uncertain and likely to remain so for the foreseeable future. Thus, the scientific community is debating how to most usefully characterize this important yet uncertain information for decisionmakers. As part of a multiyear study on climate-change decisionmaking under uncertainty, RAND researchers are working with water agencies in California to help them better understand how climate change might affect their systems and what actions, if any, they need to take to address this challenge. This report documents the methods and observations used to preserve an archive of the workshop process and provide a basis for refining the approach for future applications.



## **Producing Liquid Fuels From Coal Prospects and Policy Issues**

James T. Bartis et al., 2008

The government, as a principal, may seek to induce a private investor, as an agent, to build and operate an unconventional-oil production plant to promote early production experience with such plants. Facing significant uncertainty about the future, it also wants to limit the cost to the public of doing this. This report offers an analytic way to design and assess packages of policy instruments that the government can use to achieve its goal.



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## **Unconventional Fossil-Based Fuels Economic and Environmental Trade-Offs**

Michael Toman et al., 2008

Both high import payments for petroleum motor fuels and concerns regarding emissions of carbon dioxide (CO<sub>2</sub>) are motivating interest in possible fuel substitutes. This report assesses the potential future production levels, production costs, greenhouse gases, and other environmental implications of synthetic crude oil extracted from oil sands and fuels produced via coal liquefaction relative to conventional petroleum-based transportation fuels. The findings indicate the potential cost-competitiveness of these alternative fuels and the potential trade-offs that their deployment requires between economic and environmental considerations.



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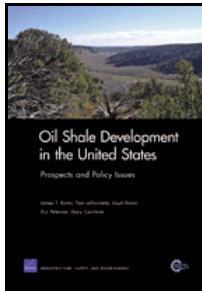
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## **Evaluating the Benefits and Costs of Increased Water-Use Efficiency in Commercial Buildings**

David G. Groves et al., 2007

This report presents an analytical framework and describes a spreadsheet-based tool to help commercial building owners make reasoned judgments about various water-efficiency investment options. The framework considers the costs that are typically incurred when improving efficiency and seeks to include many tangible financial benefits.



## **Oil Shale Development in the United States Prospects and Policy Issues**

James T. Bartis et al., 2005

In the late 1970s and early 1980s, when crude oil prices were high, government and private-sector energy experts took a hard look at the costs and benefits of extracting oil from the vast deposits of oil shale that lie beneath the western United States (much of it under government land). In this report, the authors describe the oil shale resources (estimated at more than triple the proven oil reserves of Saudi Arabia); the suitability, cost, and performance of technologies for developing these resources; and the key energy, environmental, land-use, and socioeconomic policy issues that need to be addressed by government decisionmakers. The authors conclude by outlining both the challenges and opportunities for early action with regard to those policy issues.

*Updated 7/6/2009*