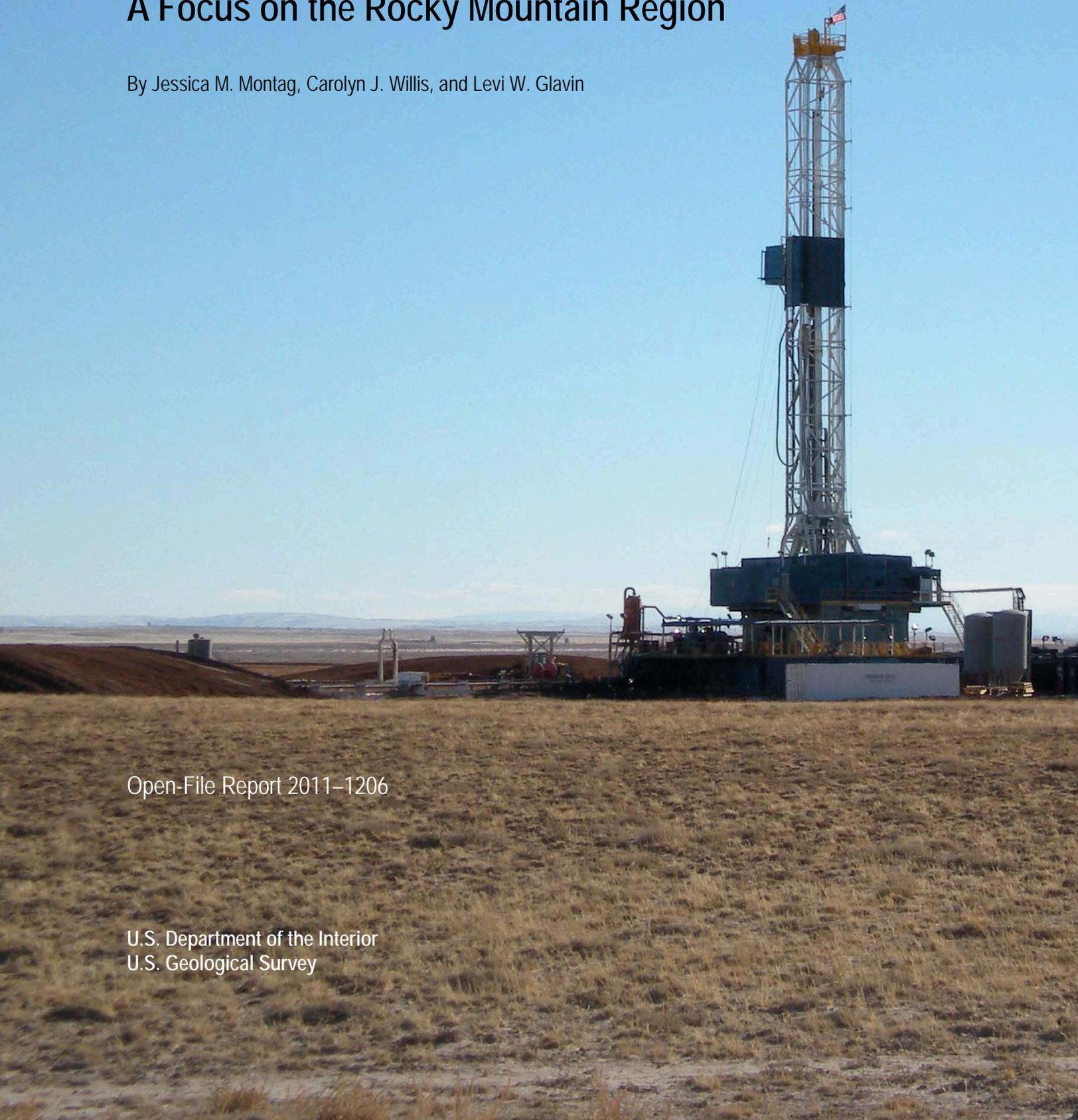




Abbreviated Bibliography on Energy Development— A Focus on the Rocky Mountain Region

By Jessica M. Montag, Carolyn J. Willis, and Levi W. Glavin



Open-File Report 2011–1206

U.S. Department of the Interior
U.S. Geological Survey



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Executive Summary

Energy development of all types continues to grow in the Rocky Mountain Region of the western United States. Federal resource managers increasingly need to balance energy demands, effects on the natural landscape and public perceptions towards these issues. To assist in efficient access to valuable information, this abbreviated bibliography provides citations to relevant information for myriad of issues for which resource managers must contend.

This abbreviated bibliography is not meant to be all encompassing, but instead attempts to present the range of issues and research that has been examined over time. From June 2010 through September 2010 numerous databases were searched as well as specific journals in order to identify appropriate citations. Citations are grouped according to applicable and relevant sub-categories under the categories of: broad energy discussions, energy sources, natural landscape effects, human landscape effects, research and technology, international research, and methods and modeling.

A future goal is to expand this abbreviated bibliography and develop a web-based citation database for U.S. Geological Survey researchers and collaborators.

Introduction

The Rocky Mountain Region (RMR) (fig. 1) of the United States is an area rich in energy resources. We have defined the RMR as these eight states: Idaho, Montana, Wyoming, Utah, Colorado, New Mexico, Arizona, and Nevada. These eight states have unique landscapes on which energy development may have lasting effects. Understanding the research on energy development and the associated effects, both positive and negative, is a necessary first step for adeptly managing and balancing the effects of energy development on natural landscapes and human communities.

Land management agencies within the Department of the Interior (DOI), in particular the Bureau of Land Management (BLM), must contend with balancing energy development with other land uses and values. Such issues and the decisions made to effectively resolve them are often controversial and complex, necessitating easy access to useful data, literature, and other informative resources that facilitate better understandings of various effects that result from energy development.

The goal of this abbreviated bibliography is to provide references to a range of literature and research conducted through August 2010. These references will guide land and resource managers to available literature. This abbreviated bibliography is just that: abbreviated, and thus not meant to be all-encompassing and comprehensive. In this bibliography, there is an emphasis on providing citations for literature describing energy development and associated effects potentially applicable to the RMR. There is, therefore, a lack of discussion of effects from offshore-based energy

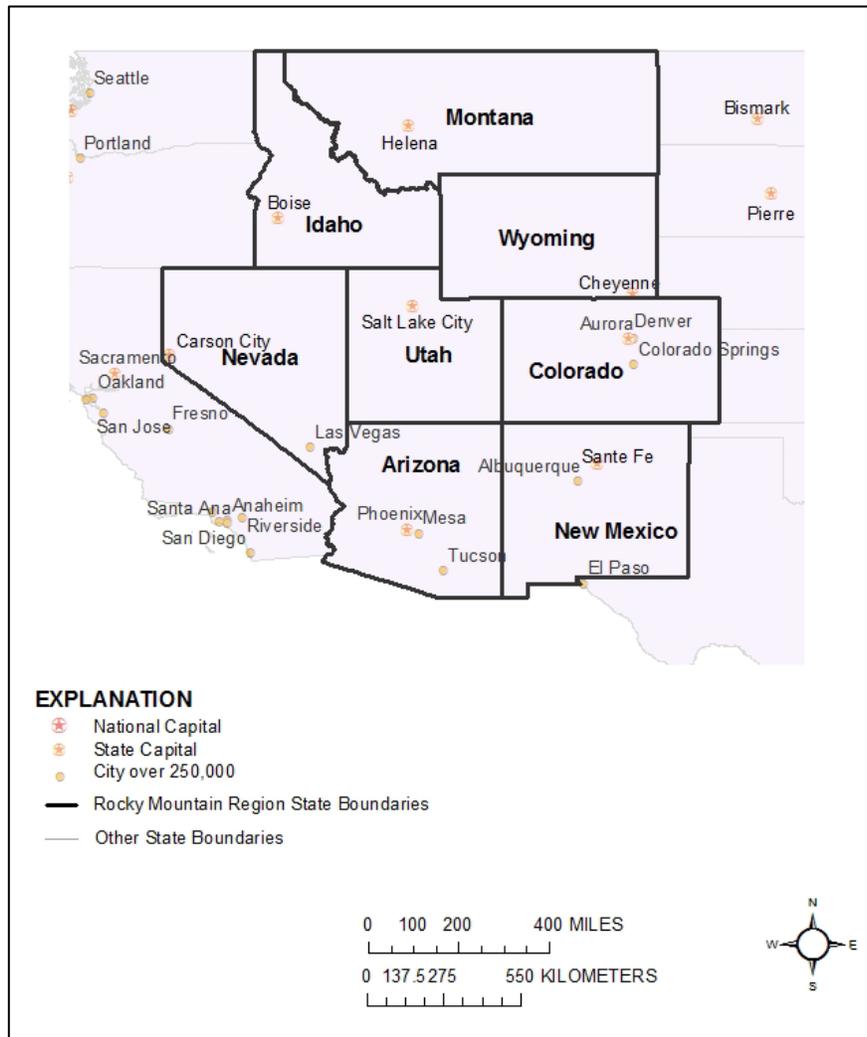


Figure 1. Rocky Mountain Region, United States.

development, such as offshore oil wells, offshore wind farms, and tidal energy, as well as a lack of detailed energy life-cycle assessments and the geological aspects of energy sources. For individuals interested in petroleum pollution, especially pertaining to coastal and marine effects, Albers (1998) has an excellent bibliography. This is available online at: <http://www.fws.gov/contaminants/pdf/Alberspetroleum.pdf>. Another excellent bibliography that focuses more on the social, political, and economic realms associated with energy development is by Rudolph (1995). This bibliography covers a considerable amount of research done in the 1970s. Therefore, while we have included 1970s literature in order to give a sample of the range of research that has been done; we chose to limit the amount of 1970s literature in order to focus on the more recent literature that was not already covered in Rudolph (1995).

The first section of the bibliography briefly discusses the types of energy development occurring in the RMR as a way to highlight this area's importance for energy resources. The second section provides information on how the bibliography was developed, including the

databases searched and a select list of search terms, how the citations were organized, and the name of the categories used. The third section outlines the future goal of moving beyond this abbreviated bibliography by developing a web-based citation and resource database for USGS researchers and collaborators. The final section presents the citations.

Rocky Mountain Region

The RMR provides considerable fossil-fuel resources, hydroelectricity, and increasing amounts of solar- and wind-based energy. The RMR as a whole has played a growing role in United States fossil-fuel production, especially natural gas and coal production (table 1). Figures 2–4 highlight crude oil, natural gas, and coal production in the RMR’s-highest producing states. The downward trend for crude oil production and upward trends for both natural gas production and coal production are notable. In 2008, the RMR provided over 50 percent of the coal produced in the United States and over a quarter of the natural gas, indicating that fossil fuel resources and development are considerable aspects for RMR land and resource managers to consider. As an example, the figures show that the state of Wyoming is a considerable producer of these resources in the RMR. It led in crude oil production until 1998 (fig. 2) and took the lead in natural gas production in 2006 (fig. 3). Wyoming is also the highest coal-producing state in the RMR, having produced over 450,000 thousand short tons (fig. 4). This amount of production has made Wyoming the leading coal producer in the United States (U.S. Energy Information Administration, 2010b).

Table 1. Rocky Mountain Region crude oil, natural gas, and coal production as percentage of U.S. crude oil, natural gas, and coal production. Percentages devised from U.S. Energy Information Administration, 2010a.

	Crude oil thousand barrels	Natural gas million cubic feet	Coal thousand short tons
1970	10.7%	7.9%	4.7%
1975	11.3%	9.4%	11.7%
1980	9.1%	9.7%	22.4%
1985	9.5%	9.9%	26.7%
1990	9.4%	12.0%	29.0%
1995	8.7%	16.7%	38.0%
2000	8.4%	20.2%	44.1%
2005	9.8%	26.7%	48.5%
2008	10.5%	27.9%	51.4%

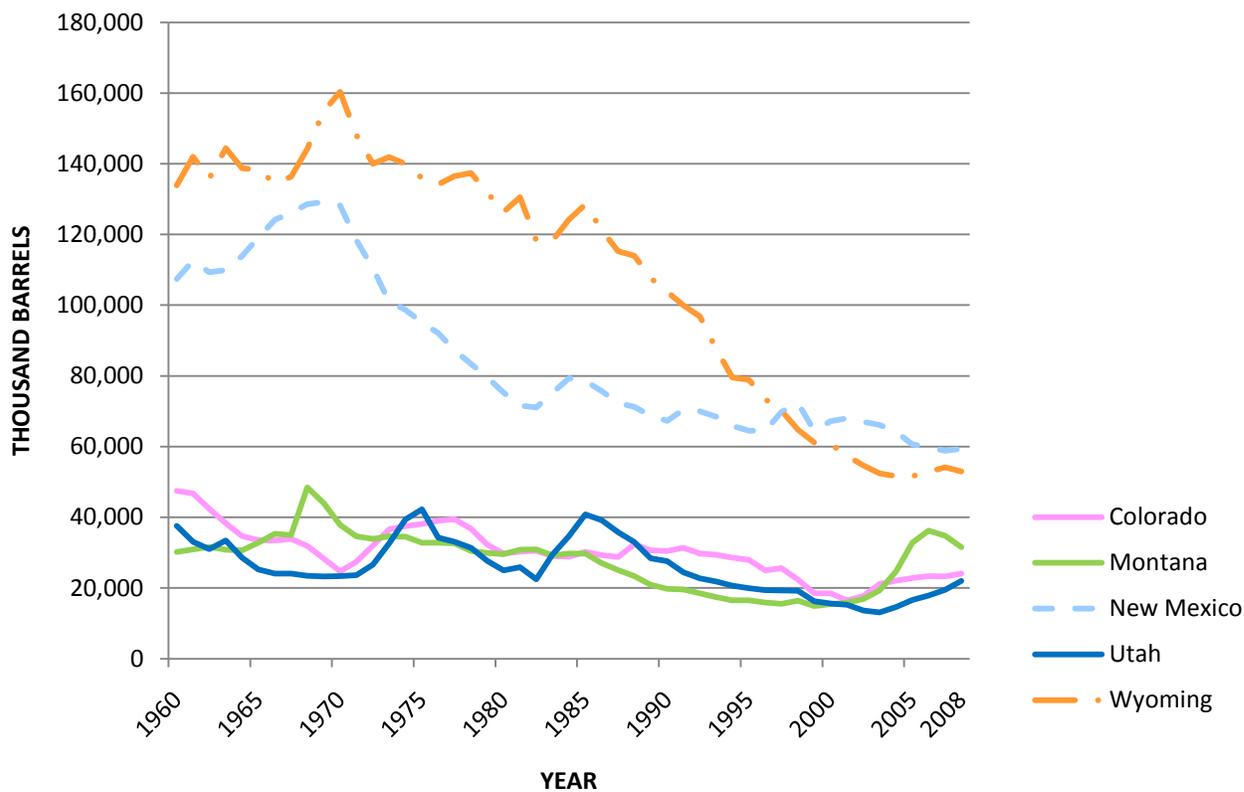


Figure 2. Crude oil production in the Rocky Mountain Region, 1960–2008. 1960–2008 crude oil production data from U.S. Energy Information Administration, 2010a.

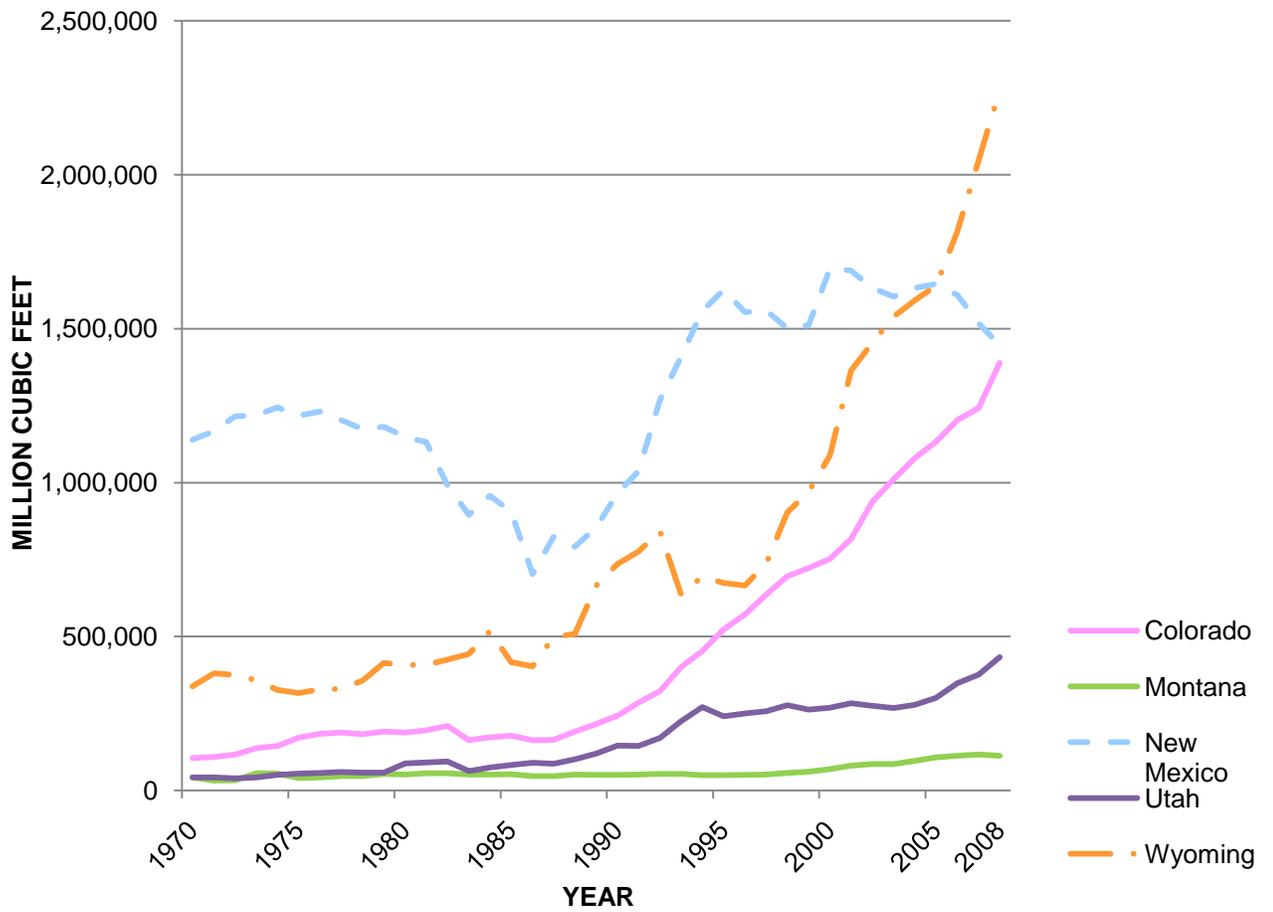


Figure 3. Natural gas production in the Rocky Mountain Region, 1970-2008. 1970-2008 natural gas production data from U.S. Energy Information Administration, 2010a.

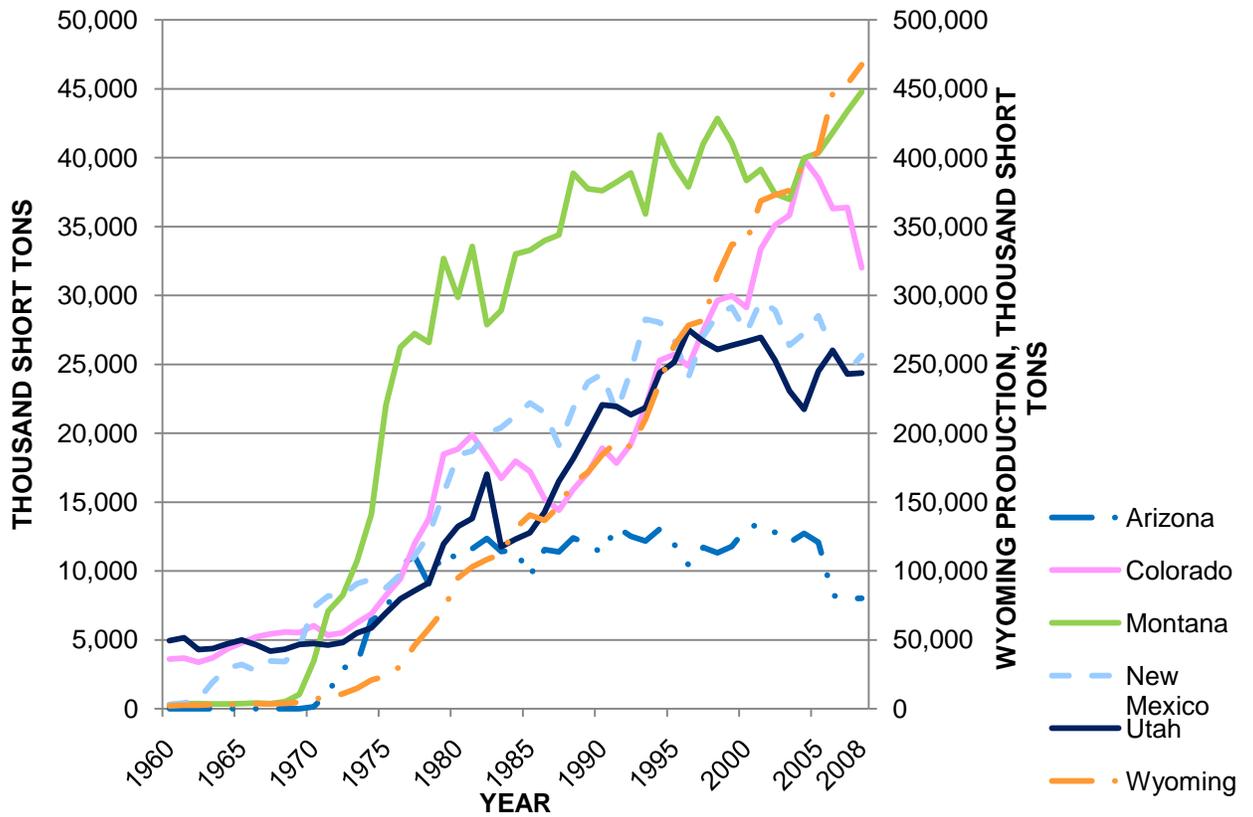


Figure 4. Coal Production in the Rocky Mountain Region, 1960–2008. 1960–2008 coal production data from U.S. Energy Information Administration, 2010a.

Renewable energy is also produced in the RMR, including geothermal, hydroelectricity, solar, wind, wood, and biomass. Table 2 presents the amount of electric power that is generated by these renewable resources for each RMR state in 2008. One can identify that in 2008, Montana produced the highest amount of renewable electric power generation in the RMR and it ranked sixth in the Nation as a whole (U.S. Energy Information Administration, 2010c). Idaho was close behind, ranking seventh in the United States and its renewable electric power generation was only 704 thousand megawatthours (Mwh) lower than Montana's (U.S. Energy Information Administration, 2010c). The high ranking of these two states is likely due to their hydroelectricity generation (10,000 thousand Mwh in Montana, 9,363 thousand Mwh in Idaho). As a whole, 77 percent of the RMR's renewable electric power generation came from hydroelectricity (table 2). Wind power was the next highest, producing 16 percent of the renewable electric power in the RMR in 2008. Although renewable-energy production has not reached the levels of fossil-fuel production in the RMR, the societal push for development of renewable energy resources will likely pertain to several land- and resource-management decisions.

Arizona is the only state in the RMR that contains a nuclear power plant. Palo Verde Nuclear Generating Station in Arizona is the largest nuclear power plant in the United States and generates close to 25 percent of the state's electricity (U.S. Energy Information Administration, 2010d). In 2008, Arizona generated approximately 29,000 thousand Mwh of nuclear power (U.S. Energy Information Administration, 2010d). When discussing nuclear power, one should not overlook one of its main components: uranium. Wyoming has consistently provided most of the United State's uranium since 1995 (Wyoming State Geological Survey, 2010) and has the largest known reserves in the United States (U.S. Energy Information Administration, 2010e). Arizona, Colorado, and Utah as a group, and New Mexico by itself, also have considerable known uranium reserves in comparison to the total of the United State's uranium reserves (U.S. Energy Information Administration, 2010e). The remaining RMR states also have uranium reserves, but those reserves are considerably smaller (U.S. Energy Information Administration, 2010e). Thus, nuclear power and the associated uranium development provide other issues to be considered by land and resource managers in the RMR including issues associated with water quality and habitat disturbance.

Due to the extent of energy development and the vast natural resources within the RMR, federal and state land and resource managers contend with numerous issues and concerns when balancing energy development/production with both natural and human landscapes. While this discussion on energy development in the RMR is quite brief, it highlights the diverse types and the amount of energy development that land and resource managers may encounter. Additionally, it should be noted that much of this energy development does not occur in isolation; in several areas, multiple energy sources can be and are developed. Considering the various techniques used to acquire and develop these energy sources, such as drilling, mining, in-situ leaching, wind turbine erection, and solar panel installation, there are a multitude of potential effects upon the natural and human landscapes. Efficient access to valuable literature on previous research (the goal of this abbreviated bibliography) should provide land and resource managers with assistance in dealing with energy development and its potential effects.

Table 2. Rocky Mountain Region renewable electric power generation, 2008. 2008 renewable electric power generation data from U.S. Energy Information Administration, 2010c.

[MSW, municipal solid waste; -, no data reported; *, absolute percentage less than 0.05; s, Value is less than 0.5 of the table metric, but value is included in any associated total]

2008 Electric Power Generation (thousand megawatthours)		Geothermal	Hydroelectric	Solar	Wind	Wood/ wood waste	MSW biogenic/ landfill gas	Other biomass
Arizona	thousand megawatt hours	-	7,286	15	-	76	19	4
	% of state electricity generation	-	6.10%	*	-	0.10%	*	*
Colorado	thousand megawatt hours	-	2,039	18	3221	s	8	37
	% of state electricity generation	-	3.80%	*	6%	*	*	0.10%
Idaho	thousand megawatt hours	86	9,363	-	207	455	-	-
	% of state electricity generation	0.70%	78.20%	-	1.70%	3.80%	-	-
Montana	thousand megawatt hours	111	10,000	-	593	111	-	-
	% of state electricity generation	0.40%	33.70%	-	2%	0.40%	-	-
Nevada	thousand megawatt hours	1,383	1,751	156	-	-	-	-
	% of state electricity generation	3.90%	5%	0.40%	-	-	-	-
New Mexico	thousand megawatt hours	-	312	-	1643	-	-	19
	% of state electricity generation	-	0.80%	-	4.40%	-	-	0.10%
Utah	thousand megawatt hours	254	668	-	24	-	24	-
	% of state electricity generation	0.50%	1.40%	-	0.10%	-	0.10%	-
Wyoming	thousand megawatt hours	-	835	-	963	-	-	-
	% of state electricity generation	-	1.80%	-	2.10%	-	-	-

Bibliography Development and Organization

This section outlines how the abbreviated bibliography was developed and the categories in which we have grouped the citations. Again, we emphasize that this is not meant to be an exhaustive bibliography with all known citations. The purpose is to help show the range of research that has been conducted in order to help land and resource managers think about energy development and associated effects. While we have attempted to provide a helpful selection of citations, it is up to the reader to judge the quality of the research for themselves.

As noted below, there are several energy-related citation databases that were incredibly helpful in compiling this abbreviated bibliography. Each database tended to provide different types of citations, whether in terms of forms of documents, such as federal agency reports; specific issues, such as wildlife and wind energy; or energy sources, such as oil and gas. An excellent bibliography that focuses more on the social, political, and economic realms associated with energy development is by Rudolph (1995). This bibliography covers a considerable amount of research done in the 1970s. Therefore, while we have included 1970s literature in order to give a sample of the range of research that has been done: we chose to limit the amount of 1970s literature in order to focus on the more recent literature that was not already covered in Rudolph (1995). Our abbreviated bibliography attempts to bring the various types of citations together while also acknowledging the valuable resources that these databases provide.

Approach

Starting in June 2010 and extending through September 2010, detailed searches for applicable literature were conducted. While after September 2010 we did not conduct detailed searches, we have included literature that we came across through December 2010. Since new literature is always becoming available, a focused time for compiling the citations was needed in order to publish the bibliography.

In keeping with the focus of this effort, key search terms and term combinations focused on energy development and possible associated effects, both positive and negative, on the natural and human landscapes. Using a variety of applicable terms and term combinations (see table 3 for a list of selected terms which were used both as individual terms and in combination with other terms), we specifically searched the following citation databases: CSA Illumina, GeoRef, GeoScienceWorld, GreenFILE, Groundwater and Soil Contamination Database, ScienceDirect, Scopus, Web of Knowledge, and Water Resources Abstracts. Through the U.S. Geological Survey (USGS) library system's "search the literature" function, numerous other resources were also searched (table 4).

Table 3. List of selected search terms.

attitudes	natural gas
biomass	natural gas development
coal	nuclear energy
coal production	oil
community effects	oil development
ecological impacts	petroleum
economic impacts	petroleum development
ecosystem	policy
energy	renewable energy
energy development	social impacts
environmental impacts	solar energy
geothermal	trona
groundwater contamination	uranium
hydroelectric	uranium production
hydropower	water and groundwater
impacts	wildlife
landscape	wind
mining	wind power

Table 4. "Search the literature" resources.

Academic Search Premier	JSTOR Biological Sciences Collection
Access Science	JSTOR Ecology and Botany Collection
American Chemical Society Web Edition	JSTOR Health and General Science Collection
American Fisheries Society	JSTOR Life Sciences Collection
American Institute of Physics Publications	Lyell Collection
American Statistical Association Publication	MasterFile Premier
Aqualine	Mining Communications Online Journals
ArticleFirst	Nature Journals Online
ASCE Research Library	NetLibrary eBooks
ASTM Journals	Open J-Gate
BioOne Abstracts and Indexes	Oxford Journals
BioOne	PION Journals
Birds of North America Online	Royal Society Publications
Cambridge Journals Online	SAGE Premier 2007
Columbia Gazetteer of the World	Science and Technology
CSIRO Publishing Journals	Science Magazine
Current Contents Connect	SEG Research Collection
Directory of Open Access Journals	SpringerLink Contemporary (1997–Present)
Electronic Books	University of Chicago Press Journals
Electronic Collections Online	USGS Online Catalog
Environment Complete	Wiley-Blackwell Full Collection
GeoRef in Process	WorldCat (OCLC Online Union Catalog)
GeoScienceWorld	WorldCat Dissertations and Theses
Inter-Research	

We also conducted searches in various online resources including: the Energy Citation Database (<http://www.osti.gov/energycitations/index.jsp>), the Wyoming Energy Resources Information Clearinghouse (<http://www.weric.info/documents.htm>), Energy Science and Technology Virtual Library (<http://www.osti.gov/energyfiles/about.html>), International Energy Agency publications (<http://www.iea.org/publications/index.asp>), Knowledge Management Database Portal (<http://www.netl.doe.gov/KMD/>), Intermountain Oil and Gas BMP Project (<http://www.oilandgasbmps.org/bibliosearch.php>), and Wind-Wildlife Impacts Literature Database (WILD) (<http://www.nrel.gov/wind/wild.html>). Additional searches were conducted on the websites of numerous journals which we believed could have applicable literature (table 5). Several of these journals were searched through some of the above citation databases, such as ScienceDirect and Scopus; however, we believe that looking at the journals individually allowed us to tailor more specific searches depending on the journal's general content. These journals may also prove useful for land and resource managers as new research is published.

Table 5. Journal websites searched.

Annual Review of Energy	Journal of Energy, Natural Resources and Environmental Law
Annual Review of Energy and the Environment	Journal of Energy and Natural Resources Law
Annual Review of Environment and Resources.	Journal of Environmental Management
Applied Energy	Journal of Land, Resources, and Environmental Law
Biomass and Bioenergy	Journal of Mammalogy
Carbon and Climate Law Review	Journal of Renewable Energy Law and Policy Review
Electricity Journal	Journal of the American Water Resources Association
Encyclopedia of Energy	Journal of Wildlife Management
Energy	Journal of World Energy Law and Business
Energy and Fuels	Land Use Policy
Energy Conversion and Management	Landscape Research
Energy Economics	Minerals and the Environment
Energy for Sustainable Development	MRS (Materials Research Society) Bulletin
Energy Law Journal	Natural Resources and Research
Energy Policy	Nonrenewable Resources
Environmental and Energy Law and Policy Journal	Nuclear Engineering and Design
Environmental Impact Assessment Review	Oil and Energy Trends
Environmental International	Oil and Gas Journal
Environmental Quality Management	OPEC Energy Review
Environmental Science and Policy	Renewable and Sustainable Energy Reviews
Environmental Science and Technology	Renewable Energy
Frontiers in Ecology and the Environment	Resources
Fuel and Energy Abstracts	Resources Policy
International Journal of Energy Research	Rural Sociology

International Journal of Hydrogen Energy	The Science of the Total Environment
International Journal of Life Cycle Assessment	Solar Energy Materials
Journal of Applied Ecology	Society and Natural Resources
Journal of Energy and Environmental Research	Technology in Society
Journal of Energy, Climate, and the Environment	Wildlife Society Bulletin
Journal of Energy Law and Policy	Wind Energy

Categories

The development of the categories in which we placed citations was a process that evolved as we gained a better understanding of the literature. In keeping with this effort, we primarily wanted literature pertaining to energy development and associated effects on the natural and human landscapes. Initially, we outlined the various energy sources, biophysical factors on the natural landscape, and the components that comprise the human landscape. From that list of categories, we were able to further refine categories through combining similar categories, creating more overarching categories, and re-evaluating the focus of the literature. There is a multitude of ways to categorize these citations, and we have attempted to create intuitive and effective categories that would be applicable to land and resource managers.

We grouped categories and sub-categories under seven overarching themes:

- Broad Energy Discussion
- Energy Sources
- Natural Landscape Effects
- Human Landscape Effects
- Research and Technology
- International Research
- Methods and Modeling

Table 6 identifies the full list of categories and sub-categories. The listing of the categories and sub-categories highlights the interconnectedness of the issues surrounding energy development and its associated effects. Therefore, citations will be found under multiple appropriate categories. This allows the reader to find relevant citations for a category or sub-category in one place without having to navigate through several categories or sub-categories. For example, if a person is interested in the oil resources and water, applicable citations are available under both the oil sub-category and the water sub-category. We did, however, try to reduce redundancy through the development of the list of categories and sub-categories; this is the reason for not having even more sub-categories. Additionally, it should be noted that in the process of categorizing citations, several citations appear under categories which are not necessarily implied by the title alone. This is due to our attempt to categorize citations based primarily on the content of the document. There is, of course, the caveat that the placement of citations in appropriate categories was at times subjective. Therefore, readers may think citations should be included in other categories or sub-categories.

While the main geographical focus of this abbreviated bibliography was on the RMR, international research is included to highlight the range and types of energy-related research occurring worldwide. That said, we omitted numerous international research citations when more applicable citations to the RMR existed. Under main category headings, we have a brief description of the intent and focus of that category.

Table 6. Themes, categories, and sub-categories of abbreviated bibliography.

Broad Energy Discussions	Energy Sources	Natural Landscape Effects	Human Landscape Effects
Energy Crisis	Exergy	Climate Change	Attitudes and Perceptions
Energy Efficiency and Conservation	Fossil Fuel	Greenhouse Gases	Community and Social Effects
Energy Supply and Demand	Coal	Natural Carbon Dioxide Emissions	Rural
Consumption	Natural Gas	Ecosystem	Economics
Sustainable Energy and Energy Security	Coal-Based Dimethyl Ether	Landscape Concerns and Land Use	Cost
National Security	Coalbed Methane	Agriculture	Tax
Sustainable Development	Methane	Mining	Health and Safety Concerns
War	Oil Shale	Mitigation, Restoration, and Reclamation	Native Americans
Energy Systems	Petroleum	Pollution and Waste	Politics, Policy, and Regulation
Analysis	Diesel	Water	
Electricity	Gasoline	Fish	Research and Technology
Planning and Management	Oil	Wildlife	
Transmission	Tar Sands	Bats	International Research
Electricity	Nuclear Energy and Uranium	Birds	
Gas	Renewable Energy	Grouse (Sage and Prairie)	Methods and Modeli
Nuclear	Biomass	Mammals	
Oil	Biofuel		
Solar	Hydrogen		
Wind	Geothermal Energy		
Transportation	Hydroelectric Energy		
	Solar Energy		
	Wind Energy		
	Thermal Energy		
	Trona		

Future Goals

While this abbreviated bibliography provides valuable resources, it is just a look at the literature at one moment in time. As research continues and issues surrounding energy development and use evolve, land and resource managers could use an easily accessible resource that provides continual current literature and online resources. Researchers with the USGS would also benefit from such a resource, given that energy research is a high priority of current science and that numerous USGS researchers are involved in large scale, multi-agency/multi-stakeholder energy initiatives.

As mentioned before, there are several valuable online resources. However, these are spread across numerous websites and are often focused on only a few key components (for example, oil and gas literature, wind energy and wildlife, etc.). Development of a web-based energy-resource database comprised of pertinent foundational and current literature citations; links to relevant, energy-related online resources; and research efforts would provide USGS researchers and land and resource management collaborators with an efficient mechanism to access the latest data and research references.

The four main objectives of this effort would include:

- development of a “living” web-based literature-citation database of foundational and current research that can be easily queried,
- compilation of online resources,
- identification and prioritization of valuable journals and books which include relevant and current energy research, and
- determination of the accessibility of those sources.

It is not the goal of this effort to provide an all-encompassing and comprehensive literature-citation database, but to provide a range of literature which describes research that has been conducted and to point to additional appropriate resources that currently exist online. The database will be a “living” database in that it will be frequently reviewed and updated in order to provide the most up-to-date citations and related online resources.

Broad Energy Discussions

This section covers a wide range of energy-related issues. It discusses general development and retrieval of various energy sources, the systems that implement energy delivery and use, and the perceived efficiency or inefficiency of various energy types.

Energy Crisis

The sources listed below represent decades of discussion about past, current, and future use of energy (particularly oil). All of the sources, starting as far back as the 1970s, discuss the estimated amount of energy resources available to the United States and present various projections on how both an energy shortage and solutions to that shortage may affect the world (particularly the United States). Because the emphasis of this abbreviated bibliography is on the effects on the natural and human landscapes, we limited the selection of sources pertaining to energy crisis. However, we still believe it is important to include this category to provide context to the energy-development discussion.

Abrahamsson, B.J., ed., 1976, *The changing economics of world energy*: Boulder, Colo., Westview Press, 165 p.

Andrew, R.B.F., 2001, *Population and the demise of cheap energy: Politics and the Life Sciences*, v. 20, p. 217–226.

Balaban, O., and Tsatskin, A., 2009, *The paradox of oil reserve forecasts—The political implications of predicting oil reserves and oil consumption: Energy Policy*, v. 38, no. 3, p. 1340–1344.

Bellaby, P., 2010, *Uncertainties and risks in transitions to sustainable energy and the part ‘trust’ might play in managing them—A comparison with the current pension crisis: Energy Policy*, v. 38, no. 6, p. 2624–2630.

Biswas, A., 1984, *Energy and agriculture—Their interacting futures, policy implications of global models: Energy Policy*, v. 12, no. 4, p. 469–470.

Blair, J.M., 1976, *The control of oil*: New York, N.Y., Pantheon Books, 441 p.

Boulding, K.E., 1974, *The social system and the energy crisis: Science*, v. 184, no. 4134, p. 255–257.

Brooks, H., 1981, *Perspectives on the energy problem: Proceedings of the American Philosophical Society*, v. 125, 7 p.

Duggan, J.L., and Cloutier, R.J., 1977, *Energy sources for the future*, in *Symposium on energy sources for the future*, Oak Ridge, Tenn., April 1977, *Proceedings: Oak Ridge, Tenn., Oak Ridge Associated Universities*, 308 p.

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Energy Efficiency and Conservation

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Energy Supply and Demand

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Energy Systems

This section has been broken up into five subsections. The Analysis subsection references reports that have reviewed and critiqued various systems of energy production, use, and sustainability. The Electricity subsection references research done on how various types of energy produce electricity, how it is then used, and their associated effects. The Planning and Management subsection provides sources that highlight discussions of supply/demand management, planning integration of renewable and non-renewable energy into the electrical grid, and how to bridge science with policy. The Transmission subsection deals specifically with how electric, gas, nuclear, oil, solar, and wind energies are transmitted to sites for use and the various external and internal transmission costs incurred. The Transportation subsection, conversely, studies the costs, environmental effects, and socio-economic influence, and other issues that deal with transportation modes themselves.

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Energy Sources

This category categorizes the gathered resources according to the various energy sources. While many sources may cover one energy type, such as wind power, there are other articles and reports that span a wider range, such as comparing fossil fuels to biofuels. For that reason, there is occasional but necessary repetition between the subheadings.

Exergy

While not a source of energy in and of itself, exergy is the measurement of energy that is available to be used after processing. It is therefore an important factor in studying sources of energy and how they can be used. This topic covers a variety of different energy types.

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Renewable Energy

Renewable energy is an ever-evolving science. There are sources listed here that deal with the subject en masse and others that deal with just a few of the different types of renewable energies that have been developed. Biomass has its own subsection and is further broken down into biofuel and hydrogen. Geothermal, hydroelectric, solar, wind, and thermal energy all have their own sections as well.

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Climate Change

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Ecosystem

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Landscape Concerns and Land Use

Land use plays an integral part in every aspect of energy development and use. A variety of issues are covered in the citations presented below, including discussions on the tracts

necessary to sustain wind and solar farms, the effects of mining and drilling, and the social and political concerns for environmental integrity and appeal. Issues pertaining specifically to agricultural and mining are broken into separate subheadings.

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Wildlife

The effects of energy, both development and use, on wildlife is widespread. In this section, many of the citations are dedicated to understanding the effects of wind energy, transmission lines, and indirect products of energy development on various species of birds and bats. There are fewer citations for other animals, such as big game species, likely indicative of a need for further research in that realm. The first set of citations pertains to wildlife more generally, while the remaining citations are presented in sub-categories. Research focused on fish is located under the Water sub-category.

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Human Landscape Effects

The human landscape is comprised of components and sub-components which allow our cultures to exist. These include meeting our basic needs, our social and political systems, lifestyle and behavior aspects, and economics and basic demographics. There is a myriad of interactions between the human landscape and energy development and use. Land and resource managers need to balance the effects of development on both the natural and human landscapes with the demand for energy. The citation sources are grouped into: attitudes and perceptions; community and social effects; economics; health and safety concerns; Native Americans; and politics, policy, and regulation.

Attitudes and Perceptions

While not always quantifiable, the opinions people cultivate towards various energy types, technologies, and energy uses affect everything from development capabilities to government policies for future energy use. Many of the sources cited below focus on how the public receives information on various energy types, the attitudes and perceptions they already

have and build upon as far as energy and those who supply it are concerned, and the issues that various communities may focus on at any given time, like landscape preservation and pollution.

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Community and Social Effects

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Health and Safety Concerns

Nuclear power plant operation and byproducts, the noise and flicker effect produced by wind turbines, pollution produced by both renewable and non-renewable energy sources, and the costs associated with treating the resulting health issues that can arise are among the many topics covered in this section.

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Politics, Policy, and Regulation

Energy development, use, and the associated effects can have local, regional, national, and international interest. The sources discussing the political nature of energy development often pertain to the energy market, energy security, and climate change. Through policies and regulations past, current, or proposed, governments attempt to guide energy development and use. Many of the sources below discuss these topics.

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Research and Technology

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International Research

The resources listed below pertain to research done on every aspect of energy in countries outside of the United States. The purpose for this section is to inform readers about the the range of research that has been done. Additional value is gained by comparing these sources' results with domestic research—this comparison can guide future energy development.

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Methods and Modeling

The sources cited below cover a range of methods and modeling that has occurred (or is discussed as needing to occur) to better understand the dynamics of energy development and use, the natural landscape, and the human landscape. The range of methods and modeling discussed in the sources includes optimization models, presenting future scenarios, risk modeling, integrated modeling, and methods for specific research (such as habitat studies).

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