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AMERICAN JOBS AND ENERGY SECURITY: DOMESTIC OIL SHALE—THE STATUS OF RESEARCH, REGULATION AND ROADBLOCKS

OVERSIGHT FIELD HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES

OF THE

COMMITTEE ON NATURAL RESOURCES
U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED TWELFTH CONGRESS

FIRST SESSION

Wednesday, August 24, 2011, in Grand Junction, Colorado

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OVERSIGHT FIELD HEARING ON "AMERICAN JOBS AND ENERGY SECURITY: DOMESTIC OIL SHALE—THE STATUS OF RESEARCH, REGULATION AND ROADBLOCKS."

Wednesday, August 24, 2011
U.S. House of Representatives
Subcommittee on Energy and Mineral Resources
Committee on Natural Resources
Grand Junction, Colorado

The Subcommittee met, pursuant to call, at 9:05 a.m., at Grand Junction City Hall, 250 North 5th Street, Grand Junction, Colorado, Hon. Doug Lamborn [Chairman of the Subcommittee] presiding.

Present: Representatives Lamborn and Tipton.

STATEMENT OF THE HON. DOUG LAMBORN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF COLORADO

Mr. LAMBORN. The Committee will come to order. The Chairman notes the presence of a quorum, which under Committee Rule 3(e) is two Members. The Subcommittee on Energy and Mineral Resources is meeting today to hear testimony on an oversight hearing on American Jobs and Energy Security: Domestic Oil Shale—The Status of Research, Regulation, and Roadblocks.

Under Committee Rule 4(f), opening statements are limited to the Chairman and Ranking Member of the Subcommittee. However, I ask unanimous consent that Mr. Tipton be permitted to give an opening statement and to include any other Members' opening statements in the hearing record if submitted to the clerk by close of business today.

Hearing no objection, so ordered.

Mr. LAMBORN. I now recognize myself for 5 minutes.

Thank you all for being here today. This is a very important topic.

I am Congressman Doug Lamborn, and I have the privilege of not only representing Colorado in the Congress, but I am also Chairman of the House Natural Resources' Subcommittee on Energy and Mineral Resources.

I am especially pleased that my colleague, Scott Tipton, is here. Representative Tipton has made a big impression in just the few months he has been in Congress and on this Committee in particular, and he is known as a staunch defender of the interests of the 3rd Congressional District.

And in honor of being in the 3rd Congressional District, I wore my Mesa Verde tie——

[Laughter.]

Mr. LAMBORN. Which is one of the highlights of the vast and beautiful 3rd District, a manmade wonderful place to visit. I urge

everyone here to go there if you haven't already, especially visitors here. I am sure hometown people have already been there.

But there are so many wonderful things in the 3rd District to do and to see, and that is one of the things that we need to talk about here at this meeting today. I think that we can balance all of the competing needs that are so important.

We have the environment with protected species. We have environmentally sensitive fish and other wildlife that need to be protected for tourism. We need to have water protected. That is such a tremendous and important resource here in the West. We need an opportunity for jobs to be created and for the economy to grow. So I think that we, as Americans, can accomplish all of these things at the same time.

Our Subcommittee has broad jurisdiction over onshore and offshore energy production on public lands. Obviously, much of that we have here in the West. And these are issues that affect every one of us here in Colorado.

Today, we are here specifically to discuss one of the most challenging, tantalizing, and promising sources of energy our country has to offer, oil shale. The United States is blessed with tremendous oil shale resources. Nearly 75 percent of the world's recoverable oil shale is estimated to be located in this country, and we have been called by some the "Saudi Arabia of oil shale."

Much of that is located right here around us in this three-State region, where, according to the U.S. Geological Survey, the Western United States may hold more than 1.5 trillion barrels of oil, enough to provide us, if it were to be used and produced, with energy for the next 200 years.

Unfortunately, the oil shale development has historically been characterized by boom and bust, industrial surges due to inconsistent and sometimes contentious Federal policies regarding leasing and land development. As Federal land contains about 80 percent of the known recoverable resources in the West, these policies are sometimes significantly hindering the research and development projects that could lead to commercial oil shale production.

In 2005, the House of Representatives passed the Energy Policy Act of 2005, which directed the Department of Energy and the Bureau of Land Management to expand their work on oil shale. Accordingly, in 2007, six areas of land were leased for oil shale projects.

However, since then, the Obama Administration has shown little support or interest in the advancement of these projects. Shortly after taking office, they delayed RD&D leases and offered a second round of leases with new, revised, and restrictive lease terms that were so uninviting to oil shale production that industry showed almost no interest in procuring this valuable land.

Although they did receive some applications, the leases have yet to be issued. To add further burdens to the process, in February, the Obama Administration announced that they would be reviewing the current rules for commercial oil shale leasing, adding further delays to an already unreasonably prolonged process.

While oil shale development is still in its infancy in the United States, other countries, such as Brazil, Estonia, Jordan, and China, support substantial oil shale industries without having nearly the

same amount of oil shale resources that we have here. Instead of promoting American jobs and developing cutting-edge, clean technologies to utilize these resources and lead the way in global development of this resource, the Obama Administration has stonewalled its production, diverted resources that could be used for oil shale RD&D, and continues to put up roadblocks for companies that want to utilize Federal land for energy production. I find this extremely troubling.

I am especially looking forward to our witnesses' thoughts on how we can successfully expand the oil shale industry while preserving a resource that we in the West work hard to conserve—water. Striking a balance between energy production and water management is, and continues to be, an extremely important issue for our region. It is vital that we continue to safeguard this precious natural resource while at the same time creating jobs for our citizens and producing homegrown energy for all Americans.

Again, I want to thank our witnesses for taking time out of your busy schedules to be with us today. Thank you all for being here, and I look forward to hearing from the testimony shortly.

At this point, I would now like to recognize Representative Scott Tipton for an opening statement.

[The prepared statement of Mr. Lamborn follows:]

Statement of The Honorable Doug Lamborn, Chairman, Subcommittee on Energy and Mineral Resources

Thank you everyone for being here today. I'm Congressman Doug Lamborn and I not only have the privilege of serving you all in my home state of Colorado, but I am also the Chairman of the House Natural Resources Subcommittee on Energy and Mineral Resources. Our subcommittee has broad jurisdiction over onshore and offshore energy production on public lands, much of which we have here in the West—and issues that affects every single one of us in from the state of Colorado.

Today we are here to discuss one of the most challenging, tantalizing, and promising sources of energy our country has to offer—oil shale. The United States is blessed with tremendous oil shale resources—nearly 75% of the world's recoverable oil shale is estimated to be located in this country and we have appropriately been called the "Saudi Arabia of oil shale." Most of that shale is located right here around us, where according to the U.S. Geological Survey, the Western United States may hold more than 1.5 trillion barrels of oil –enough to provide the United States with energy for the next 200 years.

Unfortunately, oil shale development has historically been characterized by "boom and bust" industrial surges due to inconsistent and combative federal policies regarding leasing and land development. As federal land contains about 80 percent of the known recoverable resources in the West, these policies are significantly hindering the research and development projects that could lead to commercial oil shale production.

In 2005, the House of Representatives passed the *Energy Policy Act of 2005* which directed the Department of Energy and the Bureau of Land Management to expand their work on oil shale. Accordingly, in 2007 six areas of land were leased for oil shale projects. However, since then, the Obama Administration has shown little support or interest in the advancement of these projects. Shortly after taking office they delayed RD&D leases, and offered a second round of leases with new, revised lease terms that were so uninviting to oil shale production that industry showed nearly no interest in procuring this valuable land. Although they did receive applications, the leases have yet to be issued. To add further burdens to the process, in February the Obama Administration announced they would be re-reviewing the current rules for commercial oil shale leasing, adding further delays to an already unreasonably prolonged process.

While oil shale development is still in its infancy in the United States, other countries such as Brazil, Estonia, Jordan, and China support substantial oil shale industries without nearly the amount of oil shale resources we have in our country. Instead of promoting American jobs and developing cutting edge clean technologies to utilize these resources and lead the way in global development of this resource, the

Obama Administration has stonewalled its production, diverted resources that could be used for oil shale RD&D, and continues to put up roadblocks for companies that want to utilize federal land for energy production. This is extremely concerning.

I am especially looking forward to our witnesses' thoughts on how we can successfully expand the oil shale industry while preserving a resource that we in the West work hard to conserve—water. Striking a balance between energy production and water management is, and continues to be an extremely important issue for our region. It is vital that we continue to safeguard this precious natural resource while at the same time creating jobs for our citizens and producing homegrown energy for all Americans.

Again, I want to thank our visitors for taking time out of your busy schedules to be with us today and look forward to hearing from our witnesses.

STATEMENT OF THE HON. SCOTT TIPTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF COLORADO

Mr. TIPTON. Thank you, Congressman Lamborn. I would like to thank you for conducting this hearing.

I want to join with him as well in thanking all of our witnesses for taking the time out of your busy schedules to come in and talk about a very important issue and for everyone else in attendance as well.

We have some real challenges that we are facing as a Nation when we look at what is going on right now in the Middle East, the turmoil in Egypt, in Libya, Syria, Jordan, and the challenge of Iran perhaps getting a nuclear weapon, which will further destabilize the Middle East.

When we look at the importance of the flow of oil coming out of the Suez Canal not only for the American economy, but for the world economy as well, the time is appropriate for the United States to grasp the reins of its own economic future, its own energy future. The 3rd Congressional District of Colorado can play a very important role.

Recently, President Obama made an announcement favoring $1 billion going to Brazil to be able to develop their resources off of their shores and proclaimed that we wanted to be one of their best customers. The question that crossed my mind is, if we are going to be making an investment, wouldn't it be better to invest dollars on American soil, developing American resources, putting Americans back to work, creating an opportunity to get the American economy moving once again?

For me, that is an easy answer. As I travel throughout the 3rd Congressional District—so far during this break, I have been from Cortez to Grand Junction. I will be in Steamboat down to Pueblo, down to Trinidad, over to Alamosa. As we go through every one of our communities, I think many of us who live here, it breaks our hearts as we drive through our communities, and we are seeing closed stores. We are seeing businesses that are facing a challenge.

As I have walked down Main Street, Grand Junction, I have shaken hands with people that are worried about their economic future. Mothers that are worried about being able to provide for their children.

We have to get this economy moving. Energy plays an important role in that. But we are also very cognizant here in the 3rd Congressional District of the valuable resource that we have called our public lands. The beauty of our landscapes, the value of our water, the value of the air that we breathe.

Well, it has been my experience going out, the people that are working in developing our natural resources breathe that same air, drink that same water. We can develop these resources responsibly. We can create a win-win. It does not have to be a win-lose scenario in the United States of America.

We are truly talking about the future of our Nation. If we are going to capitulate our ability to be able to provide energy, to be able to drive the economic engine, which means providing for our families, putting roofs over our head and food on our table, we have that opportunity. The 3rd Congressional District can play a very important role in doing that.

We will all stand guard to make sure that it is done responsibly. We will hold the industry accountable to make sure that that is done. But it is important that we take this opportunity at this point in time to make sure that we are developing responsibly American resources on American soil and getting Americans back to work.

I am very appreciative of Congressman Lamborn holding this hearing in regards to oil shale. As he noted, we have the potential to have 1.5 trillion barrels of oil. That doesn't even include the natural resources that we have in natural gas as well.

I am an "all of the above" sort of a guy. I think that we need to be developing wind, solar, geothermal. It is going to be the entire package to be able to move to economic certainty and an energy certainty for America.

This district can play a very important role, and I thank you for conducting I believe this very important hearing. Again, I thank all of our witnesses for taking the time to be here, as we explore this and see where we can create those opportunities to create a win-win for America and to be able to get our people back to work and get the American economy moving once again.

Thank you.

[The prepared statement of Mr. Tipton follows:]

Statement of The Honorable Scott Tipton, a Representative in Congress from the State of Colorado

Thank you Mr. Chairman for convening today's hearing, and thanks to the panelists and the folks from the Third District for being with us today in Grand Junction to examine this very important issue.

The USGS indicates that there are as many as 1.5 trillion barrels of recoverable oil shale in the United States, the vast majority of which is in Colorado, Wyoming, and Utah. Of this, some of the most promising reserves are in the Pineance Basin in northwest Colorado. As a result, the Third Congressional District of Colorado, along with our neighboring western states, are in a unique position to contribute to our nation's energy security, ensure that the United States remains competitive in the world market, and to create much needed jobs here at home.

The world's primary energy demand has grown by more than 50% since the year 1980 and this growth is expected to continue at an annual rate of 1.6% during the 30 years. Over 70& of this growth is expected to come from developing countries and fossil fuels are estimated to provide the vast majority of the energy during this period, even with increased efforts towards production of renewable energy sources and new technological advancements in the renewable energy sector. While we must continue to support the development of all our domestic energy resources, it is naïve to think that renewable resources can replace hydrocarbons in the near future. For the sake of our national security, our economic stability, and our ability to remain competitive in the world market, we must continue to move towards new innovations in unconventional oil production, most notably, oil shale here in the Western United States.

Because 72 percent of the oil shale in this area is beneath lands governed by the Department of the Interior, the policies of this administration and those to come play a significant role in whether or not we are able to make wise use of these resources. The road to viability for the oil shale industry is reliant on a predictable regulatory structure and an environment in which companies can invest in research and development and create jobs. To this end, it is critical that the federal government remove duplicative approval processes and help, rather than hinder development in the United States. The proper implementation of our environmental and safety regulations already on the books is a far better strategy than adding additional layers of bureaucracy to the process. By establishing a common sense regulatory framework and embracing research and development of oil shale, we can continue to remain competitive, ensure national security, and provide an environment for job creation here in western Colorado and in our neighboring western states.

Mr. LAMBORN. All right. And thank you.

I also should note for the record that the Ranking Member, Representative Rush Holt of New Jersey, very much wanted to be here. We talked on the phone. He just couldn't rearrange his schedule enough to make it work to be here.

It did not help matters when we had originally scheduled this for late July at a time when we were going to be back in our districts and not in Washington, but we had to change everything because of those important debt ceiling negotiations that required us to be in Washington after all during that week. So everything got turned around.

I would like to now hear from the invited witnesses, and I want to ask forward Ms. Helen Hankins, Colorado State Director of the Bureau of Land Management, and Mr. Ronald C. Johnson, Oil Shale Assessment Project Chief for the U.S. Geological Survey. This is our first panel.

We were going to have one more larger panel, but what we are going to actually do is have two smaller panels because of space limitations. So we will have a total of about 10 witnesses that we are going to hear from who are experts in various facets of this important subject.

But now we will start with these two in particular. Like all witnesses, your written testimony will appear in full in the hearing record. So I ask that you keep your oral statements to 5 minutes, as outlined in the invitation letter to you and under Committee Rule 4(a).

Our microphones are automatic. So you do not need to turn them on when you are ready to begin, and you will see the timing light, which will go on. After 4 minutes, it will turn yellow and then, after 5 minutes, will turn red.

Ms. Hankins, you may begin. Thank you for being here.

STATEMENT OF HELEN HANKINS, COLORADO STATE DIRECTOR, BUREAU OF LAND MANAGEMENT, ACCOMPANIED BY RONALD C. JOHNSON, OIL SHALE ASSESSMENT PROJECT CHIEF, U.S. GEOLOGICAL SURVEY

Ms. HANKINS. Thank you very much for the invitation to speak before this Subcommittee hearing.

As stated, my name is Helen Hankins. I am the State Director for the Bureau of Land Management in Colorado.

Mr. LAMBORN. And Ms. Hankins, if you can make sure that you talk into the microphone so everyone can hear you. Thank you.

Ms. HANKINS. It is my pleasure to discuss the oil shale program of BLM and the Department of the Interior this morning.

As we know, oil shale is a very abundant resource in the Western United States, particularly Colorado, Wyoming, and Utah. A recent assessment, actually several assessments by the U.S. Geological Survey indicate that there are 4.3 trillion barrels of oil present in place in these States.

We have had a long history of interest in oil shale dating back to the late 1800s, when anecdotal information tells us that a homesteader built a fireplace of oil shale and during a housewarming party not only saw his fireplace, but his home go up in flames.

Even since those days and particularly in the last three or four decades, people have continued to have an interest in oil shale development. But to date, we do not yet have a commercially viable, environmentally responsible approach here in the United States.

The Energy Policy Act of 2005 provided that the Department of the Interior establish a program for research, development, and demonstration leases; that we complete a programmatic environmental impact statement for identification of available lands for oil shale and tar sand development; and that we launch a commercial leasing program for oil shale and tar sands.

In 2008, a programmatic EIS was completed as required by this Act, and 8 of BLM's land use plans were amended to provide for 1.9 million acres being available potentially for oil shale development. In 2006 and '07, in what is referred to as "round one," six leases were issued for research, development, and demonstration projects. Work is actively going on on all of these leases.

In 2010, based on industry's request, the Secretary determined to initiate a second round of RD&D nominations. Three of those nominations have been advanced, and those companies are currently completing environmental assessment work, which must be completed before leases can be issued.

The BLM's goal, as we manage this important program on the public lands, is to provide an opportunity for companies to develop new generation of technology that ensures that we have environmentally responsible development, commercially viable operations, and that we can provide a fair return to the American public for the extraction of this resource and the use of these public lands.

We are currently beginning a new planning process with the development of a programmatic environmental impact statement to reexamine lands that are suitable for oil shale leasing and potential development. We also, at the same time, are undertaking a review of the regulations that were developed previously to make sure that we have an environmentally responsible and sound management approach to oil shale development.

Many of us here can recall the oil shale leases that were issued in the 1970s and some of the concerns associated with those. Those lessons have helped us remember that we must have an understanding of environmentally acceptable development and commercially viable operations before we approve leases of large acreages for the development of this resource.

Research, development, and demonstration projects are key to advancing oil shale development on public lands. They help companies test their bench-scale technologies at the field level, and they

provide an opportunity to evaluate various aspects of development, including environmental concerns.

There are several questions that we all need to be thinking about and which Representative Lamborn and Representative Tipton alluded to in their opening remarks. One of the key things is, are the current technologies going to be commercially viable and environmentally responsible?

We also need to make sure that we have an understanding of the potential impacts on our Western lands, wildlife—habitat and wildlife, and water as we proceed with the development of this industry. As was addressed by both of our Representatives, water is a key factor here in the West, and it is, of course, not of boundless supply. So part of our analysis needs to consider water availability in the arid West in which we live.

These are fundamental questions which we need to be sure that we address as we proceed with our efforts. BLM is interested in a balanced and orderly approach, but we want to ensure that we address these environmental concerns, water issues, and commercially viable operations.

Thank you for the opportunity to appear before your Subcommittee today. And at the appropriate time, I will be happy to answer any questions you may have.

[The prepared statement of Ms. Hankins follows:]

Statement of Helen Hankins, Colorado State Director, Bureau of Land Management, United States Department of the Interior

Good morning. My name is Helen Hankins, and I am the state director of the Bureau of Land Management's Colorado office. It is my pleasure to testify before you on the Department of the Interior's Oil Shale Program here in the Centennial State, which, along with Utah and Wyoming, is home to the nation's largest reserves of oil shale.

Background

Oil shale is a type of rock that contains kerogen, a waxy organic material that can be refined to make oil. It is a resource that the nation has been trying to unlock for the past century because it is so abundant. U.S. resources are approximately 4.3 trillion barrels of oil in place, a significant portion of the world's resources, according to the U.S. Geological Survey (USGS). However, after many attempts to develop the resource, no one has yet discovered how to extract it economically on a commercial scale.

The Energy Policy Act of 2005 directed the Department of the Interior to establish a leasing program for oil shale research and development, publish a programmatic environmental impact statement (PEIS), and launch a commercial leasing program. In 2008, the BLM published the PEIS that amended eight resource management plans in Colorado, Utah, and Wyoming to make approximately 1.9 million acres of public lands potentially available for commercial oil shale development and 431,224 acres for tar sands leasing and development.

In 2006 and 2007, the BLM issued six oil shale Research, Development, and Demonstration (RD&D) leases. The BLM's goal is to provide an opportunity for companies to develop a new generation of oil shale technologies by establishing an orderly and environmentally responsible program that provides a fair return for taxpayers. In 2010, the BLM advanced three nominations for a second round of RD&D leases. For a variety of reasons, the BLM began a new planning process this year that would take a fresh look at what public lands are best suited for oil shale and tar sands development. This planning process will not disturb RD&D activities already under way; rather, any information developed from RD&D activities may help inform this planning process. In addition, the BLM anticipates taking a fresh look at the regulations governing oil shale development to ensure they reflect a sound management approach.

The BLM's RD&D program is essential to encouraging companies to test their bench-scale technologies and to help answer fundamental questions about how oil shale might be safely and economically developed on a commercial scale. The RD&D

program began with the intent of avoiding the mistakes of the 1960s and 1970s, which left a legacy of spent shale piles, contaminated runoff, and multimillion dollar cleanups. One need not look further than the Naval Petroleum Oil Shale Reserves 1 and 3 here in Colorado to know that the oil is extractable, but at a significant cost to the environment and taxpayers. Approximately $25 million has been spent on clean-up and monitoring that continues to this day. The work has included excavating spent shale and preparing a storage vault to protect a tributary of the Colorado River from potentially hazardous runoff.

The BLM learned from four leases issued in Utah and Colorado in the 1970s that companies must first demonstrate that their technology is economically viable and environmentally sound before approving a development process that could potentially disturb thousands of acres of public lands. On "Black Sunday" in 1982, a major oil shale player shutdown its oil shale development efforts, called the Colony Project, putting 2,000 people out of work in single day, and demonstrating the potential harm when communities count on an industry that hasn't proved the sustainability of its proposed development.

USGS Resource Assessments

The Green River Formation in the Piceance Basin (Colorado), the Uinta Basin (Utah and Colorado), and the Greater Green River Basin (Wyoming, Colorado, and Utah) contains one of the largest known oil shale deposits in the world. Recent USGS assessments estimate an in-place oil volume of 1.53 trillion barrels in the Piceance Basin (http://pubs.usgs.gov/dds/dds-069/dds-069-y/), 1.32 trillion barrels in the Uinta Basin (http://pubs.usgs.gov/dds/dds-069/dds-069-bb/), and 1.44 trillion barrels in the Greater Green River Basin (http://pubs.usgs.gov/fs/2011/3063/). The oil shale deposit in the Piceance Basin is probably the world's most concentrated oil shale resource with as much as 400,000 barrels of oil in place per acre. It is important to note that these resource assessments are in-place resources rather than technically recoverable resources because there is currently no commercial oil shale development in the United States.

The mineral nahcolite is associated with high-grade oil shale deposits in the Piceance Basin, and because it is important as a leasable mineral, the USGS assessed its resource potential as well. Nahcolite has an in-place resource estimate of 43 billion short tons. The nahcolite is intimately associated with the oil shale horizons in the richest part of the basin and therefore will be affected by any oil shale development in that area.

The U.S. Geological Survey recently subdivided the 1.53 trillion barrels of in-place oil shale in the Piceance Basin into several subsets (http://pubs.usgs.gov/fs/2010/3041/). Of the 1.53 trillion barrels total, about 920 billion barrels (60 percent) exceed 15 gallons of oil per ton of oil shale (GPT), and about 352 billion barrels (23 percent) exceed 25 GPT. More than 67 percent of the total in-place resource, or 1.027 trillion barrels, is located under Federal lands. About 689 billion barrels (75 percent) of the 15 GPT total and about 285 billion barrels (81 percent) of the 25 GPT total are under Federal mineral (subsurface) ownership. An evaluation of the Federal oil shale resources in Wyoming is nearing completion and should be available in the near future.

Development Questions

There are several issues that need to be addressed before a successful commercial oil shale program will be economically viable.

The first is whether the technologies that are currently being developed can become viable on a commercial scale. Some of the technologies under development would require vast amounts of energy, increasing production costs and creating a burden on the power grid. The companies working on these challenges report generally that they are several years away from knowing whether their technologies will work on a commercial scale.

The second is to understand the potential impacts of commercial oil shale development on Western lands, wildlife, and watersheds. Historically, the techniques of retorting or milling the shale have caused serious environmental consequences, creating large concentrations of contaminants in areas not designed to contain them. In the arid West where water supplies are extremely limited, much hinges on the question of water. Accordingly, we must have a better understanding of the impacts of oil shale development on the water supply.

The Government Accountability Office studied the issue of oil shale development impacts on water resources, and determined in an October 2010 report that: "Oil shale development could have significant impacts on the quality and quantity of water resources, but the magnitude of these impacts is unknown because technologies are years from being commercially proven, the size of a future oil shale in-

dustry is uncertain, and knowledge of current water conditions and groundwater flow is limited." To address these important water questions, the USGS has begun to gather baseline data that would be used to analyze groundwater and surface water systems that could be affected by commercial-scale oil shale development.

In light of the many fundamental questions about oil shale that need to be answered, it is vital that the BLM administer a balanced, carefully planned RD&D program. As the BLM takes a fresh look at the regulations governing oil shale development, it will ensure that the regulations reflect the latest information about water, potential environmental considerations, and uphold its responsibility to deliver taxpayers a fair return on the development of this resource.

Moving Forward with RD&D

Of the six leases issued in 2006 and 2007, five are in Colorado and one is in Utah. Activity is under way on the RD&D lease sites. American Shale Oil, which owns one of the leases, reports that its processing facilities are 90% complete with plans to initiate pilot testing soon. Other leaseholders also report progress in establishing extraction techniques.

In the second round of RD&D leases, three nominations, two in Colorado and one in Utah, advanced in October 2010. Analysis under the National Environmental Protection Act (NEPA) is under way to examine how the proposed technologies will affect the environment. Issuance of those leases will depend largely on the results of the NEPA analyses and other factors as the nominees refine their individual processes for developing oil shale.

This is an exciting time as these companies move forward, testing new technologies to harness this abundant resource. At the Department of the Interior, we are pleased to be part of the effort to keep the oil shale program on an orderly and successful path, encouraging development while ensuring environmental protection.

Conclusion

Thank you again for the opportunity to testify on the Oil Shale Program. I would be glad to answer your questions.

Mr. LAMBORN. All right. Thank you so much.

I should note for clarification that Mr. Johnson won't be directly testifying but is available to answer technical questions as needed.

I will go ahead and start with questions. I will recognize myself. First of all, a very quick question, then a couple of longer questions.

Ms. Hankins, as you know, the Administration is currently reviewing a second round of oil shale RD&D leases. Can you tell us when we can expect a final decision on this second round of potential leases?

Ms. HANKINS. The timeframe on when the bureau will make decisions on those RD&D leases depends on when the companies involved complete the environmental assessment work and those environmental assessments are reviewed. Right now, each of those three companies are in the midst of doing that environmental review.

So I am not able to give you a precise estimate. But I can tell you that the companies are diligently pursuing that effort, and as soon as we receive their environmental documents, we will very carefully and diligently look at them and proceed as quickly as possible with the next steps.

Mr. LAMBORN. OK. Now a little bit lengthier question. In 2009, BLM announced a second round of 160-acre oil shale RD&D leases. However, while the first round of leases allowed for the potential expansion of 5,120 acres of commercial development, in the second round of leases, the terms were decreased, and only 480 acres were available for potential expansion.

We have heard that this decrease of land available was one of the main reasons for industry's apparent lack of interest in the second round of leases. Can you tell us the reason for this large decrease in potential land expansion and what new information that BLM relied on that led them to change the original terms?

Ms. HANKINS. Unfortunately, Representative Lamborn, I cannot address that question because I was not involved in those discussions. However, I will be happy to provide a written response to the Committee on that question.

Mr. LAMBORN. OK. I would really appreciate that answer in writing later.

Mr. Johnson, would you have anything to add to that?

Mr. JOHNSON. No, I don't.

Mr. LAMBORN. OK. Well, Ms. Hankins, going on to the next question, in April of this year, BLM announced plans to re-review the 2008 programmatic environmental impact statement—we referred to that earlier—for the development of oil shale resources. Can you tell us what substantive new information has been brought to your attention that warrants an entire re-review of a barely 3-year-old document that is very lengthy—2,000 pages already and—well, I will have a follow-up. But first of all, that part of the question. What new information came to you that you felt it necessary to re-review the PEIS?

Ms. HANKINS. The Secretary of the Interior has the discretion at any time to review previous decisions—in this case, an allocation decision relating to which lands might be available for development of oil shale. And it is an authority that he has.

In this particular case, I think there are a number of factors that were considered. One is that because this is an industry that is still in its infancy, it was thought to be a good idea to evaluate whether we have new information about new technology, about economic viability of some of that technology.

Also there has been a report released about the need to look at some of the water issues, which I alluded to in my testimony. That report was published by the General Accounting Office. And there are other concerns relating to sage grouse and great concern about their potential listing as an endangered species range wide across 11 Western States. New information has come forward on some of their habitat and priority use areas.

In addition, new information is available on some plants that are potentially threatened and endangered. So, for all of those factors, as well as concerns raised in litigation in 2009 challenging the 2008 PEIS and regulations, all of those things are factors in why the Secretary has decided to take a second, fresh look at these issues while the industry is still in its infancy.

I might add that this new look will not affect the six existing leases. They will still proceed on the course that they are on.

Mr. LAMBORN. All right. Thank you.

At this point, I would like to recognize Representative Tipton for questions.

Mr. TIPTON. Thank you, Congressman Lamborn.

And Ms. Hankins, thank you for being here. Good to see you again.

Ms. HANKINS. Always.

Mr. TIPTON. Appreciate your testimony. When we look at some of the real challenges we face as a country, it is energy. We also have some of the issues in terms of what are called rare earths. And perhaps Mr. Johnson, with a little bit of backup on this, may be able to speak to that.

Has the BLM explored some of the rare earths that may also be available out of the oil shale?

Ms. HANKINS. I don't have information to address that question. But I would be happy to provide information after the hearing. —

Mr. JOHNSON. There have been studies in the past of elements within the oil shale itself, and I don't have those with me. But there may be some minor amounts of rare earth in oil shale. We could provide that later.

Mr. TIPTON. You know, that might be something that we really want to explore in terms of looking at the entire package of resource development. It is my understanding and there is the potential to have aluminum, lithium, a variety of different elements that may be in there in addition to the oil shale, and those are all, obviously, some important issues for America as well, since we are now relying primarily on the Chinese for a lot of the rare earths since we have closed down a lot of the mining industry in this country, to be able to develop those resources.

So I would appreciate some follow-up information on that. I think that that is important in terms of having the entire universe of information and looking at where we are heading.

Ms. Hankins, maybe you can give us just a little bit of background. I grew up here on the West Slope, and I remember looking out at Grand Junction, we saw some of the boom and bust cycle when we had Unocal, when we had Occidental Petroleum, I think, coming in and trying to establish some of that early development for oil shale.

Can you tell me what steps that you are observing, since you are working with the industry and we have six leases that seem to be proceeding right now in the process, what are some of the steps that are being taken to be able to avoid that boom/bust cycle?

Ms. HANKINS. I think one of the reasons that we are undertaking this new programmatic environmental impact statement is to provide us yet another opportunity to look at not only the resource and how it might be developed, but also to look at concerns related to socioeconomic impacts, infrastructure development, et cetera, of such a possible development. One of the opportunities that we have in this sort of process is to make recommendations for what might assist with making sure that we minimize the boom/bust cycle.

Of course, that is not entirely within the control of the Bureau of Land Management. But we have an opportunity to look for mitigation options as we look at economics as part of our analysis, and I think it remains to be seen what those recommendations will be. But we can address that in our process.

Mr. TIPTON. OK. Great. You know, really, one of the problems we are seeing, and we have discussed it before, one of the big challenges, it seems, to having real economic development and we will again underscore, as you noted in your testimony, and we want to make sure that things are being done responsibly. But we have heard that regulatory uncertainty is really one of the main factors

that is delaying research and technological development of oil shale.

Could you maybe speak to that? And has BLM or others that you may be aware of, have we done any sort of cost-benefit analysis in terms of continually moving the goal posts, if you will, in terms of addressing developing resources responsibly?

Ms. HANKINS. Well, as I mentioned a few minutes ago, the current effort to relook at the land allocation decisions in 2008, the PEIS in 2008, and the regulatory efforts that were also completed at the same time, look at economics and they consider a lot of these various things. But one thing that they don't do in our new effort is our new effort does not affect the current research and development that is going on on these six leases, five in Colorado and one in Utah.

And the purpose of these leases is, of course, for research and development. Nor are things that we are doing on Federal land affect the ability of companies to do research and development and evaluate various techniques on private land. So I think that our current efforts to look at land allocation and to look at the rules that we have in place to make sure they are environmentally responsible really don't preclude research and development on either the existing Federal leases or on private land.

Mr. TIPTON. Well, yet when we are talking about those five leases that are currently in Colorado, one in Utah, and they have some certainty, can you give me some kind of a timetable that they are working off of, actually, for that RD&D?

Ms. HANKINS. I believe that they are 10-year leases. But each company has to determine its own timetable based on its development, plan of development and the steps that are in that plan. Each one, of course, is unique, so there is not a set timeframe for when that development will occur.

Mr. TIPTON. So I guess it is my understanding then that, obviously, we can introduce some sort of caveat in there that may change a bit over this 10-year period. The BLM is giving some certitude in terms of the regulatory process for these companies in terms of developing the oil shale. Is that correct?

Ms. HANKINS. The companies that have the six leases—five in Colorado and one in Utah—will be given a choice. At such time, if they arrive at the time, when they want to convert these RD&D leases to commercial leases, they will have the opportunity to choose whether they wish to operate under the existing regulations. Or if there is a different set of regulations at that time, they can opt to choose that. But the choice is theirs which way they want to go.

Mr. TIPTON. Thank you. I yield back.

Mr. LAMBORN. OK. And then, if you would indulge us for some follow-up questions?

Ms. Hankins, you said you were not part of the decision-making on the lease changes. Can you tell me, do you think that the changes made for RD&D leases are more—would make the goals of the RD&D leases more or less difficult to achieve?

Ms. HANKINS. You know, I think it is important that I talk about what—the areas where I have authority to make decisions and to operate. And as the State Director of BLM, my responsibilities are

to evaluate proposals that come forward for any types of energy development, and of course, I do that through our field managers and district managers.

That is really my role in terms of oil shale. BLM participated in both round one and round two with other agencies, including representatives of State government from the three States—Colorado, Wyoming, and Utah—to look at proposals for RD&D nominations and participated in the approval of those leases for the first six, as we will in the next three. My responsibility is to deal with field issues and permitting or leasing of field activities.

Mr. LAMBORN. Well, along those lines, is BLM doing anything to make sure that there is some kind of regulatory certainty for the companies that may wish to invest large sums of money, and this could affect many jobs here in Colorado as well, as well as possible energy production that would help the whole country? So what is BLM doing to ensure that there is some kind of stability or certainty going forward?

Ms. HANKINS. I think it is important to talk about that in the context of where we are with the oil shale industry, and you know, we are yet many years away from a commercially viable, environmentally approved oil shale development project. And why I mention that is that it provides us some time to evaluate carefully not only which lands we make available, but which rules we choose to employ as a nation to manage our oil shale development.

In the case of the existing RD&D leases, there is certainty. As I mentioned, those companies know what the regulations are under which they are currently operating. They know what the royalty rates are. They know what the environmental concerns are of the Government. And so, I believe that they have certainty, and they can choose to stay on the path they are on with the existing regulations and royalty rates.

For those companies that are in the—potentially in the pipeline to receive other leases in round two, of course, they will have to evaluate how to move forward based on what comes out in the rulemaking next year. But that is not uncommon in how the Bureau of Land Management and the Department of the Interior manages minerals in general.

We have been addressing mineral exploration and development on public land since the mid 1800s, and since that time—150 years, more or less—there have been many examples of us evaluating whether or not we have appropriate environmental protection measures in place, whether we have appropriate royalties in place to ensure appropriate return to the American people.

So the process of reviewing and evaluating how we regulate industry is not new. It is part of our responsibilities as we take care of these public lands for all American people. But I think there is certainty for those who have existing RD&D leases. I think that the three that are in process, certainly they do know that we are in this review process, and it is part of how we manage minerals.

Mr. LAMBORN. Now, Ms. Hankins—and thank you for your answers—you are here as the BLM Director for Colorado. You are the Administration's witness, in effect, and you are also speaking indirectly for the Secretary of the Department of the Interior. Are you saying that you really don't have an opinion on how these recent

changes will have an impact on the possible commercial use of oil shale in the future?

Ms. HANKINS. I think, as I said, the Secretary of the Interior has broad authorities, and he has the discretion, based on a variety of inputs that he gets, on when he feels it is appropriate to reevaluate, reexamine, or take a new look at both land allocation decisions and regulatory requirements that an agency—in this case, the BLM—might wish to impose.

I believe that he is well within his prerogative to ask us to do this additional review, and I think as part of that, we need to look at environmental issues, economic issues, and make sure that the look we did 3 years ago is—a little bit longer than that—is still valid or whether we want to make some adjustments. So I believe we are on the right track, and I think it is important that we be open to new information about new technology, new environmental issues, water concerns, et cetera.

Mr. LAMBORN. Well, Ms. Hankins, I have no doubt that he has the authority to do this. You have stated that several times. I totally agree. I am curious as to whether this decision is going to have a negative impact on the research and development that we are hoping takes place so that we all know what is going to happen in the future, if anything.

Ms. HANKINS. Well, as I said, the existing RD&D leases are not affected by this ongoing planning effort or by the regulatory review. And so, those companies can continue, as they have been for some time, on their Federal leases and on private holdings that they have.

I cannot predict how this new effort might affect future endeavors because we are still very early in the process. We are some time away from even having a draft document. So, it is not possible for me to speak to what it might address or what an ultimate decision might be more than a year from now.

Mr. LAMBORN. OK. My last question is in your discussions with your colleagues in Utah, is there any different approach on the Utah side of this basin to RD&D leasing, compared to Colorado?

Ms. HANKINS. I am not intimately familiar with the activities in Utah. They are looking at a more, if you will, a traditional approach. My understanding is they are looking at more traditional mining methods as a means of extracting the oil shale and then using surface retort. Whereas, in Colorado, the proposed methods relate more to in-situ heating of the oil shale and then extracting the mineral after that point.

However, the leases in Utah, the RD&D leases, are under the same requirements as they are here in Colorado in terms of Federal law and regulation. So I would not expect them to be different in that regard. The regulations in the State of Utah under State law are different than Colorado, but I can't speak to that.

Mr. LAMBORN. OK. Thank you.

Representative Tipton?

Mr. TIPTON. Thank you, Congressman Lamborn.

I just have, I think, one follow-up question. Can you kind of clarify for me when you noted in your opening comments that there was, I believe you stated, 4.3 trillion barrels of oil potentially between Colorado, Utah, and Wyoming. Is it the BLM and the Ad-

ministration's position that this is a resource that ought to be developed?

Ms. HANKINS. You know, I don't have detailed knowledge of the grade, character, ability for extraction, and many other factors about all of those deposits. So it is difficult for me to really say should they all be developed because there are many, many variables in terms of surface resources that might have to do with endangered species. It might have to do with water quality and quantity. It might have to do with, is it reasonably and economically extractable because of the topography, the amount of overburden, and other variables?

So I don't think I really can definitively say for that 4.3 trillion barrels of oil in place how much is readily available or should be available at this point in time because there are too many factors I don't know the answer to.

Mr. TIPTON. I guess my question, actually, it is a little more refined than the broader context of it. It is just on a philosophical basis, recognizing the energy needs of this Nation—the energy challenges that we face, what is happening on the worldwide level—is it the Administration's belief that this is a resource that we should be developing in this country?

Ms. HANKINS. I think that there are a couple of responses to that. Secretary Salazar has said in his policy statements and his areas that he expects the agencies to emphasize that energy development is one of his key priorities, and it is going to be some time before we have a viable renewable energy industry in the United States that produces significant amounts of energy for us.

I believe I read recently that the President's goal is that by 2025, we are able to get 25 percent of our energy from renewable sources. But even if we are able to meet that goal, the amount of energy that we are going to need to get from conventional sources—particularly oil, natural gas, and coal—will still be significant for years to come. When we are able to have commercially viable and environmentally responsible development of oil shale leases at some point in the future, which I understand from industry is still some years away, that also will be able to be one of our sources for domestic energy.

However, having said that, it is important to talk about BLM's underlying mission, and that is a mission of multiple use. And so, the public lands that BLM manages generally are used based on decisions that we make in our land use plans, and those land use plans consider a variety of management objectives, which include watershed health, wildlife habitat, as well as energy development.

So, in general, we would likely not make a determination about energy development without taking into account other surface values and resources that are important to all of us and that you all addressed in your opening remarks. Clearly, energy is on the Secretary's agenda. It is a top priority for him, as it is for BLM. Oil shale is one component of that, but not the only component.

Mr. TIPTON. Great. Well, appreciate that. Well, I think we certainly ought to be probably submitting the question to the Secretary's office as well because we were kind of on both sides of that. We want to develop it, but maybe not—and I understand where you are coming from in that regard.

But I think that what it probably also speaks to when we are talking about economic viability, as I was listening to your answer, I heard probably from a development standpoint, a lot of uncertainty that is going to be accompanying in terms of the significant investment that developing a resource actually takes, to be able to do that. I don't know if you are going to be in contact with the Secretary. We will certainly submit a letter.

But I think we do need to have some real clarity if there is going to be a real commitment to developing resources, given the challenges that we have because I think the industry deserves to be able to understand what those economic challenges are going to be as well.

So thank you, and I yield back.

Mr. LAMBORN. All right. I want to thank Ms. Hankins for being here.

The members of the Committee may have additional questions for you. We would ask that if we submit those to you in writing, that you respond to us in writing.

Mr. LAMBORN. Thank you for being here today, and thank you for giving us your valuable time.

Ms. HANKINS. Well, thank you for the opportunity to be here.

Mr. LAMBORN. You are welcome.

Now I would like to invite the second panel to come forward. It consists of Mr. Michael Hagood, Director of Program and Regional Development of the Idaho National Laboratory; Dr. Thomas Sladek, Director of Ockham Energy Services; Ms. Jennifer Spinti, Research Associate Professor, Department of Chemical Engineering and Institute for Clean and Secure Energy of the University of Utah; and Ms. Anu Mittal, Director of Natural Resources and Environmental Division of the Government Accountability Office.

Thank you all for being here. As you are getting situated, I would just like to remind you that like all of our other witnesses, your written testimony will appear in full in the hearing record. So I ask that you keep your comments to 5 minutes, as outlined in the invitation letter.

The microphones are automatic. So you don't have to turn them on. You will see the lights turn yellow at 4 minutes and red at 5 minutes.

I want to thank you for being here. And we will start in the order of which I introduced you earlier.

So, Mr. Hagood, you may begin. Thank you.

STATEMENT OF MICHAEL HAGOOD, DIRECTOR, PROGRAM AND REGIONAL DEVELOPMENT, IDAHO NATIONAL LABORATORY

Mr. HAGOOD. Chairman Lamborn, Congressman Tipton, and members of the Subcommittee, thank you for the opportunity to testify before the Subcommittee.

My name is Michael Hagood, and I represent the Idaho National Laboratory as the Director of Program and Regional Development.

Idaho National Laboratory is one of several U.S. Department of Energy laboratories. We are an applied research energy systems laboratory with interest in looking at the development of a number of energy sources, including nuclear, fossil, and renewables. And

we also work with advanced transportation, such as electric vehicles.

And as part of this portfolio, we also engage in research associated with unconventional fossil energy sources, including oil shale. I will limit my comments today more along the lines of the research associated with oil shale development. It is based on history, technological innovation and associated investment will emerge to more effectively develop oil shale resources.

Research has been and will continue to be a critical component in successful development of such unconventional fossil energy resources, including oil shale. An example is the recent impact of horizontal drilling, fracking, and use of proppants in accessing and recovering natural gas from shale.

Another example is the innovative subsurface steam injection recovery process implemented to help unlock Alberta oil sands at depth. And on that foundation, a number of other innovations have been developed associated with the development of those resources, as well as dealing with environmental consequences.

Increasingly, research is also playing a role in better understanding the interdependencies between energy and the environment, the impacts of energy development on the environment, and ultimately the development of innovation that helps mitigate environmental impact. So relative to the concerns on water, research plays a role in understanding the baseline conditions with groundwater, surface water in the area associated with oil shale. It also looks at the potential impacts, but it is also associated with developing innovation that helps address and mitigate some of those impacts.

The United States should continue to pursue smart and environmentally responsible development of oil shale. Realizing a sizable oil shale industry can contribute significantly to U.S. energy security, but its establishment and impact could take several years. Along these lines, it is recommended that in the near term, steps be taken to implement recommendations made by the Unconventional Fuels Task Force, which was put together as a result of the Energy Policy Act of 2005, Section 369.

As a result of the findings from that task force, a strategy was developed by an ad hoc group to create an unconventional fuel strategy, which included addressing some of the challenges associated with the environment, including looking at the groundwater and surface water issues associated with oil shale.

Relative to supporting this endeavor, it is recommended to establish a regionally based, long-term integrated and focused applied research program that helps accelerate identification of the challenges and issues and implementation of solutions that would be impactful in a smart and environmentally responsible development of oil shale resources. It is also recommended that such a program leverage the rich research capabilities within the region and internationally.

The size of the oil shale resources, the magnitude, the richness, and the impact on the energy security of the United States is such that this deserves greater attention.

Thank you.

[The prepared statement of Mr. Hagood follows:]

Statement of Michael C. Hagood, Director, Program and Regional Development, Energy and Environment Science & Technology, Idaho National Laboratory

Introduction. Chairman Lambourn, Congressman Tipton, and members of the subcommittee, thank you for the opportunity to testify before the subcommittee. My name is Michael Hagood and I represent the Idaho National Laboratory. I have over thirty years of experience working in the fields of energy and environment, including participating in associated research, development and demonstration programs. I have BS and MS degrees in the field of geology and am a licensed geologist and hydrogeologist. I have been with Idaho National Laboratory since 2003 and am responsible for developing science and technology and regional programs for the Energy and Environment Directorate. My testimony today will touch upon western oil shale development and its potential impact on U.S. energy security and economy, however, the emphasis of my testimony will be on relevant research.

Idaho National Laboratory Background. Idaho National Laboratory (INL) is a science-based, applied engineering U.S. Department of Energy (DOE) laboratory dedicated to supporting missions in energy research, science, and national defense. INL has a long history in energy resource evaluation, energy systems analysis and integration, and system-of-systems engineering, coupled with a technical focus on advanced modeling and simulation, computational engineering and analyses, instrumentation and controls, and materials development and testing. INL addresses research in nuclear, fossil and renewable energy, advanced transportation and energy storage, as well as critical energy infrastructure protection. In particular, INL is known for conducting demonstrations to help reduce risks associated with deployment of technology and being an honest, independent broker of technical information.

Idaho National Laboratory also has a goal to assist in addressing regional U.S. energy and environment challenges. From this perspective, INL has taken a particular interest in energy resource development in the Western Energy Corridor, including the rich oil shale resources located in Colorado, Utah and Wyoming. INL has been engaging in oil shale research, supporting the U.S. Department of Energy and industry for several years, as well as investing in unconventional fossil energy research internally. INL partners with regional universities relative to energy and environment research, including with Colorado School of Mines, University of Utah, Utah State University Bingham Research Center, and University of Wyoming. INL has also developed technical relationships with Canadian research institutions in Alberta and Saskatchewan, which have challenges and capabilities relevant to oil shale development.

Western Oil Shale and Energy Security. The world class nature of western oil shale resources is measured in magnitude, longevity and strategic import to U.S. energy security. It is the largest hydrocarbon resource on earth and on a per acre basis is the most concentrated oil bearing resource on earth. The United States is expected to continue to rely heavily on oil through at least 2035 according to the U.S. Energy Information Administration and one would expect U.S. dependence to extend much beyond this. In the meantime, the U.S. will need to pursue securing access to reliable supplies of energy and at the same time lessen its dependence on politically and economically unstable sources of oil imports. Given this situation, western oil shale can play a substantial role in contributing to U.S. energy security.

Western Oil Shale and the Economy. Development of a substantial industry around western oil shale can lead to significant regional job creation as well as help reduce the flow of dollars being sent overseas to purchase oil. As western oil shale becomes officially recognized as a secure, known and long-term source of oil reserves, the creation of an oil shale industry would result in significant national and international investment. As an example, I would point to what has transpired in Alberta associated with oil sands development.

Western Oil Shale and Research. As world oil demand and prices continue to rise there will be increasing efforts to develop more of the unconventional fossil energy resources, such as oil shale. In parallel, technological innovation and associated investment will emerge to more effectively develop these resources. Research has been, and will continue to be, a critical component in successful development of these unconventional fossil energy resources. An example is the recent impact of horizontal drilling, fracking and use of proppants in accessing and recovering natural gas from shale. Another example is the innovative subsurface steam injection and recovery process implemented to help unlock Alberta oil sands at depth. Increasingly, research is also playing a role in better understanding the interdependencies between energy and the environment, the impacts of energy development on

the environment and ultimately the development of innovation that helps mitigate environmental impact.

Congress recognized the importance of unconventional fossil energy research when they passed the Energy Policy Act of 2005 (Act). In particular, Sec 369 of that Act focused directly on promoting the development of liquid fuels from the Nation's vast unconventional hydrocarbon resources, including oil shale, and directed the study and mitigation of technical impediments to unconventional fuels development.

Oil shale research being conducted today addresses a variety of topics, many of which are profiled in U.S. DOE's "Oil Shale Research in the United States". Research is being conducted to better understand the nature of the oil shale resource itself as well as its setting. A number of these projects are also focused on realizing a better understanding of specific and cumulative impacts on the environment. A significant need in the future is to further address oil shale development impacts on green house gas emissions, water use and quality, and air quality concerns. For example, INL is conducting modeling and bench-scale tests in an effort to better understand potential impacts of in situ heating of oil shale on groundwater quality.

Oil shale recovery and retort processes are also a major research focus, and there are several approaches being advanced. These processes exist at various levels of maturity and many are still in the research and development phase. A summary profile of these approaches can be found in U.S. DOE's report "Secure Fuels from Domestic Resources: The Continuing Evolution of America's Oil Shale and Tar Sands Industries". A particular trend in such research is addressing in situ oil shale retorts at depth. Another emerging research interest relates to reducing the energy requirements associated with oil shale development and the potential integration of renewable and nuclear energy, which have the potential to help extend the lifetime of the oil shale resource and reduce green house gases.

Research on western oil shale is being conducted by a number of regional universities, state and federal agencies, national laboratories and private industry. University and research laboratories working in this area include Colorado School of Mines, University of Utah's Institute for Clean and Secure Energy, Utah State University Bingham Research Center, Los Alamos National Laboratory and Idaho National Laboratory, along with sponsorship through the National Energy Technology Laboratory. Regional federal offices and state agencies such as U.S. Geological Survey and Utah Geological Survey are also contributing to assessing oil shale resources and their environmental setting. Private industry, primarily comprising larger companies, is investing significantly in research built around recovery and processing techniques. Relative to industry between 2007 and 2010 DOE identified twenty-nine private companies engaged in research and development.

Of special note, the Department of the Interior's Bureau of Land Management (DOI/BLM) has been advancing opportunities for oil shale (and tar sands) technology research and demonstration on Federal lands in the West through the Oil Shale Research Development and Demonstration (RD&D) Leasing Program. A first set of leases have been allocated to Shell, Chevron, American Shale Oil and Enefit American Oil (formerly OSEC). Nominations for a second set of RD&D leases are currently under review, with BLM recently announcing their reviews of three candidates for leases in Colorado and Utah.

Relevant research on oil shale is also occurring internationally. Companies which are assessing the application of their technologies to western oil shale are also conducting technology demonstrations elsewhere in the world. Technology transfer associated with already demonstrated, conventional oil shale retort operations have also emerged with the intent that these may be applied to western oil shale, including technologies derived from Estonia, Brazil, and even China. In this spirit, the U.S. has recently signed a cooperative research agreement with the republic of Estonia.

International technology transfer was recognized by Congress, as per Section 369 (h) of the Energy Policy Act of 2005, in which the Congress directed the Secretary of Energy to establish the Unconventional Fuels Task Force to "make recommendations with respect to initiating a partnership with the Province of Alberta, Canada for the purpose of sharing information relating to tar sands. Although focused on tar sands (oil sands), the associated innovation and "lessons learned" in Alberta is useful in addressing oil shale development approaches and impacts.

Oil shale research can result in direct job creation in private industry, regional research institutions and government agencies. The greater long-term positive impact on the economy, however, will be realized through the ultimate deployment of innovation that in turn helps realize substantial oil production in an environmentally responsible manner. Once a substantial oil shale industry is established in the region, accompanied by a healthy market place, one would also expect greater investment in, and contribution from, aligned research efforts that would bring ad-

ditional economic benefits. For example, with a set of more mature R&D relationships in the region, innovation would result in creation of spinoff companies and services, which would lead to creation of jobs. A rich environment comprising industry, education, research and sound policy will lead to large international investment, similar to what is being experienced with the oil shale industry in the United States.

Recommendations. In view of its size, value and longevity, western oil shale deserves greater attention. It is of international scale. The United States should continue to pursue smart and environmentally responsible development of these resources. Realizing a sizeable oil shale industry can contribute significantly to U.S. energy security, but its establishment and impact could take several years. Along these lines, it is recommended that in the near term, steps be taken to implement recommendations made by Unconventional Fuels Task Force. A strategy was proposed by the Unconventional Fuels Ad Hoc Working Group in 2008 to address these recommendations, and developed an approach for further advancing development within the Western Energy Corridor, with an initial emphasis placed on oil shale.

Relative to oil shale research, it is recommended to establish a regionally based, long-term integrated and focused applied research program that helps accelerate identification and implementation of solutions that would be impactful in the smart and environmentally responsible development of oil shale resources. It is also recommended that such a program leverage the rich research capabilities within the region and internationally.

When aligned with a healthy oil shale industry, research on western oil shale can lead to even greater economic development within the region, sustainable over this century. As witnessed in similar circumstances elsewhere, research can also lead to strengthening existing U.S. competitiveness, nationally and internationally. Beyond this, there is also the opportunity to identify and establish value added industrial enterprises built upon the oil shale energy platform.

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Mr. LAMBORN. I want to thank you for your testimony.

Dr. Sladek?

STATEMENT OF THOMAS SLADEK, PH.D., DIRECTOR, OCKHAM ENERGY SERVICES

Dr. SLADEK. Thank you. Thank you, Congressman. I appreciate the opportunity to be here.

I always look forward to coming to Grand Junction, especially during the peach season. I intend to go back to Lakewood this afternoon pursued by a cloud of fruit flies.

[Laughter.]

Dr. SLADEK. I have been involved in oil shale off and on since 1967. And although much has changed in the world since then, oil shale development in the United States still confronts many of the

same concerns—access to resources, production costs, environmental and social effects, water availability, and uncertainties about future oil prices. Other countries are facing most of the same issues as their industries emerge.

I would like to summarize the work underway in those countries and attempt to relate that experience to the potential emergence of an American industry. There are oil shale-producing industries in three countries right now—China, Estonia, and Brazil—and another country, Jordan, is moving very rapidly toward creating an oil shale industry. Rapidly, but somewhat erratically. Their recent progress has been impeded by the political unrest in the Middle East, and when they get by that, they'll get back to business, I guess.

China has produced shale oil since the 1930s, when Japan invaded Manchuria and began to extract oil to fuel their military machine. China now has one large oil plant and six small ones and two plants that make electricity from oil shale. Four oil plants and two power plants are under development.

Estonia has utilized oil shale as a source of power and oil since the early 20th century, and today, nearly all of Estonia's electricity is produced from oil shale. They also export large quantities of electricity to the surrounding countries and their power grids. Two Estonian companies currently produce oil and power from oil shale, and their plants are being expanded.

One company, Eesti Energia, is also active in Jordan and the United States. The Hashemite Kingdom of Jordan has agreements with eight prospective developers to produce cement, shale oil, and electric power from oil shale. Eesti Energia's agreement could result in the largest shale oil plant in history, plus the plant to make most of the country's electricity.

Although Brazil is not expanding its domestic oil shale industry, the national oil company Petrobras is involved in projects in Jordan, the USA, Morocco, and China. Turkey imports more than 90 percent of its fuel oil and gas and has considered developing its oil shale to reduce that dependence.

There are some interesting opportunities. One small deposit yields up to three barrels of oil per ton of rock. Very unusual material in the world.

Morocco has a memorandum of understanding with Petrobras and Total. Syria, before their political unrest, had signed an agreement with Jordan to share expertise in the development of electricity from oil shale. Egypt was examining the feasibility of developing its oil shale to conserve the country's economically important oil and natural gas reserves. I suspect that has been suspended as well.

Resource surveys and field exploration studies are underway in Canada, Thailand, and other places. There is a cement plant in Germany that makes cement from oil shale. And in Sweden, tests on the alum shale continue to determine the feasibility of recovering oil, uranium, nickel, molybdenum, vanadium, and probably rare earths if they are there.

Some very interesting work is underway in Australia, where a company from Rifle, about 60 miles east of us, called Shale Tech International, recently completed a large pilot plant which will use

the Paraho returning process to make liquid fuels from Queensland oil shale. Paraho is American technology. It was developed in Colorado to use oil shale from the Green River formation, and now it is being used in Australia.

All of these activities are very relevant to the future of an oil shale industry in the United States. Like the U.S., nearly all of the other countries that are working on oil shale consume much more oil than they produce. A few have essentially no indigenous fuel production and are totally dependent on imports with the attendant economic dislocations and security problems.

Many have small populations and economies and would have difficulty raising billions of dollars to pay for integrated oil shale plants, despite their potential economic benefits in the long term. The oil shale projects in other countries are relevant to the U.S. because they will advance understanding of the processing technologies and reduce risks associated with their deployment.

A very important benefit will be the validation of high-level engineering designs and cost estimates. Although the plants in the current and proposed industries are relatively small compared with what might be supported by the Green River oil shales, they are large enough to address many of the unknowns that must be confronted by promoters of the commercial industry. This is especially important for the retorting facilities, which are expensive to build and operate.

The growing body of operating experience and information will greatly reduce the risks associated with the commercialization phase. This progress will facilitate financing and permitting of a facility, which will ultimately mean lower product cost.

These advancements are especially important, regardless of where oil shale technology is deployed next and especially if it is deployed in the United States.

That completes my prepared statement. Any questions?

[The prepared statement of Dr. Sladek follows:]

Statement of Thomas A. Sladek, PhD, Director, Ockham Energy Services

Introduction

I started my first oil shale project in the fall of 1967, at the Colorado School of Mines, as part of my master's program in the Department of Chemical and Petroleum Refining Engineering. I set out to measure thermal conductivity factors for oil shale in the Green River formation, the huge geological entity that underlies much of northwestern Colorado, northeastern Utah, and southwestern Wyoming. My work was sponsored by Sinclair Oil Company, which wanted to simulate the transmission of heat through beds of oil shale at their property overlooking the Parachute Valley in Colorado. Sinclair's field tests in the 1950s were somewhat successful, and they were encouraged by high oil prices (almost $3 per barrel and holding) to try again. Sinclair called its process "underground retorting" or "retorting in place." The currently popular phrase *in situ* was provided later, by Latin scholars.

After graduate school, I worked in a steel mill and then on oil shale, coal conversion and tar sands processing, fuel alcohol from corn, oil shale, resource recovery from municipal waste, management of scrap tires and other special wastes, domestic independent power projects, waste-to-energy facilities, recycling and solid waste composting, international power projects, gas-to-liquids technology, recovery of energy from agricultural residues, hybrid power plants, and oil shale.

In 2007 and 2008, I was principal investigator and director of the Jordan Oil Shale Technical Assistance project. My colleagues and I conducted a feasibility study for development of the oil shale resources in The Hashemite Kingdom of Jordan and prepared a strategic plan for their commercialization. Work included reviewing the mining and processing technologies and industries under development in other countries and updating cost engineering studies from the 1970s to allow

forecasting of the product prices required to support an oil shale industry in Jordan. The client was Jordan's Ministry of Energy and Mineral Resources. The prime contractor was Behre Dolbear and Company (USA) Inc. Funds came from the U.S. Trade and Development Agency, a branch of the Department of Commerce.

In 2008 and 2009, I was engaged by the European Union to support the Euro-Mediterranean Energy Market Integration Project, or MED EMIP. My job was to develop a concept paper for creation of an oil shale council for the countries of Turkey, Syria, Jordan, Egypt, and Morocco. All of these countries have oil shale deposits and not much else in the way of indigenous fossil fuels. The council would allow them to share their experience, influence, and expertise and develop their resources in an orderly and beneficial manner. My work again included reviewing the status of oil shale technologies and projects in the Middle East, North Africa, and other regions and assessing the significance of that work for the council's members. The project was successful in that an Oil Shale Cooperation Center was established in Amman in April of 2010. The future of that center is unclear, given the social unrest in its member countries.

I would now like to describe what I learned about oil shale projects around the world and to highlight some of the implications of that work for the emerging oil shale industry in the United States.

Oil Shale Projects in Other Countries

People's Republic of China

In Liaoning Province, the Fushun Mining Group plant uses a large number of small retorts to make about 2 million barrels of oil per year from lump oil shale, plus bricks and cement from the ash. Installation of a large retort to handle fine oil shale was completed in 2010. The plant uses the Alberta Taciuk Process (ATP) technology which was developed for soil cleaning in Canada. FMG has announced plans to expand their capacity by 3 million barrels per year.

In Jilin Province, Jilin Energy & Communication Corporation produces 12 MW of electricity by burning oil shale in fluidized bed boilers. Jilin Energy is developing a plant that will use Petrosix retorts to produce 1.5 million barrels per year of shale oil, 100 MW of electricity, and cement. Six other companies produce shale oil in Jilin Province. Quantities are relatively small. And Royal Dutch Shell has established a joint venture to evaluate the potential of Shell's *in-situ* conversion process in the province.

SINOPEC has proposed to build an oil shale power plant in Guangdong province. A retorting plant has been proposed for Heinan Province. In Heilongjiang Province, PetroChina is building a plant that will make about 700,000 barrels of shale oil per year, and a larger plant has been proposed by China National Coal Company and Harbin Coal Chemical Company. Several other minerals companies have proposed oil shale projects, some involving co-processing of oil shale and coal.

Estonia

Serious development of Estonia's resources began after World War I, and today more than 12 million tonnes of oil shale is mined per year. More than 85% is burned to generate electric power. Retorting plants produce 1.6 million barrels of shale oil per year, mostly in descendents of the Kiviter and UTT retorts that were developed when Estonia was part of the Soviet empire. One of the big players is Viru Keemia Grupp AS (VKG), which operates a power station and two shale oil plants which process lump oil shale in Kiviter retorts. In December 2009, VKG commissioned a Petroter retort (a descendent of the UTT process) which produces 730,000 barrels of shale oil per year plus fuel gas and steam. VKG has a permit to pursue oil shale development in Ukraine.

The other big player is Eesti Energia AS, the national power utility. Eesti Energia operates the Narva Oil Factory, which produces about 950,000 barrels of shale oil per year in two TSK140 retorts. These process fine oil shale and are also descendents of the UTT retorts developed in Soviet times. In 2009, Eesti Energia announced plans to expand its retorting capacity by more than 2 million barrels per year by 2012. Production of fuel gas, steam, and electricity will also rise. In 2008, Eesti Energia and Finnish minerals processing company Outotec formed a joint company—Enefit—to develop oil shale processes and projects, especially in other countries. Enefit's subsidiary Oil Shale Energy Jordan is developing a retorting plant and a large power station in Jordan. Enefit American Oil has acquired the Oil Shale Exploration Company project in Utah, which could, in time, produce 57,000 barrels of shale oil per day.

The Hashemite Kingdom Jordan

Jordan's deposits are located 60 to 90 miles south of Amman. They are large, have medium yield, and might be extracted with low-cost surface mining. The oil shale and the shale oil are very high in sulfur, which complicates combustion and retorting and makes refining difficult and expensive. These defects could be offset by selling the sulfur recovered during refining, because sulfur is a valuable commodity. In January 2000, sulfur sold for $3 per long ton along the west coast of the USA; in January 2011, the price was $180 per long ton.

The Kingdom has no other significant resources of fossil fuel, and the government is committed to oil shale development. Since November 2005, the government has executed memoranda of understanding (MOUs):

- With Jordan Cement Factories Company to manufacture cement from oil shale in the El Lajjun deposit
- With Royal Dutch Shell to evaluate applying Shell's *in-situ* process to deeply buried oil shale in central and southern Jordan
- With Eesti Energia to evaluate using Enefit retorts to make at least 37,000 barrels per day of shale oil and its boilers to generate at least 440 MW of electricity
- With Jordan Energy and Mining Ltd. to investigate shale oil production using the ATP technology
- With the International Corporation for Oil Shale Investment to evaluate retorting of oil shale from the El Lajjun resource in successors to the fine-shale and coarse-shale retorts developed in Estonia during the Soviet era
- With Brazil's national oil company Petrobras to examine application of the Petrosix retorting technology. The global energy company Total S.A. is participating.
- With Russian firm Inter Rao and Jordan's Aqaba Petroleum to examine using Russian technology for oil shale mining and shale oil extraction
- With the International Company for Oil Shale Investment to evaluate development of the Attarat Umm Ghudran resource.

The agreements cover both *in situ* retorting and aboveground processing in a diverse selection of retorts, with a range of potential production capacities, in several of Jordan's oil shale areas. One agreement could produce a major power generating facility capable of meeting most of Jordan's electrical demand, and one agreement provides for recovery of a valuable byproduct—Portland cement. With these agreements, Jordan is well positioned to become a major producer of shale oil. However there are restraints. In addition to the usual issue areas—economic feasibility, land disturbance, waste management, water requirements, and environmental, social, and cultural concerns—there is competition for access to the rock, some of which may contain uranium.

Australia

Australia has very large oil shale resources, principally in Queensland, and had oil shale industries of substantial size between 1865 and 1952. In June 1997, the Stuart Project was begun near the town of Gladstone in Queensland as a joint venture between Suncor Inc. of Canada and the affiliated Australian companies Southern Pacific Petroleum (SPP) and Central Pacific Minerals (CPM). Suncor subsequently departed, and SPP absorbed CPM. A demonstration plant using an ATP retort was constructed. The plant operated intermittently from 2000 to 2004, despite resistance from environmental, tourism, and fishing groups. Although the project had significant accomplishments, it had ongoing technical problems because dryer was too small. In February 2004, Queensland Energy Resources Ltd. acquired most of SPP's assets, and Stuart was suspended. In August 2008, QERL announced that it was abandoning the ATP technology in favor of the Paraho II technology. The ATP plant was dismantled.

QER processed 8,000 tonnes of Australian oil shale in the Paraho pilot plants maintained by Shale Technology International in Rifle, Colorado. In October 2009, QERL completed a feasibility study and began a campaign to restart Stuart with Paraho retorts. The first phase of that development was completed in August 2011, with commissioning of a small processing plant containing a single Paraho retort and its cadre of ancillary equipment, on the Stuart site. The plant can process about 2.5 metric tons of oil shale per hour (vs. the 250 tonnes per hour capacity of the ATP retort). When it is fully operational, the plant will manufacture ultra-low-sulfur diesel fuel, jet fuel, fuel oil, and synthetic crude oil.

Demonstration of the Paraho retorting process is particularly significant for oil shale initiatives in the American West. Reasons include:

- Paraho is American technology, developed in Colorado to use oil shale from the Green River formation.

- Paraho's history extends back nearly 70 years to the Synthetic Liquid Fuels Act of 1944, by which the U.S. Congress, in its wisdom, involved the Federal Government in development of the western oil shale resources. The Act led to a long series of pioneering tests on oil shale mining and retorting at Anvil Points in Colorado. The Gas Combustion retort was developed there. Its successor was the Paraho retort.
- The Paraho retort was developed with emphasis on energy self-sufficiency and water conservation. These requirements are important in the remote, arid west.
- Some of Paraho's operating principles were embodied in the Petrosix retort and have been thoroughly tested in Brazil with the difficult Irati oil shale and with other unforgiving materials, such as scrap tires.
- The QER project will rise on the site of a failed oil shale project which failed, in part, because of environmental controversy. QER is aware of the challenges in this area and seems to be dealing with them constructively. Similar controversy is likely to accompany any oil shale project in the U.S.

Others

Although **Brazil** is not expanding its domestic oil shale industry, the national oil company Petrobras is involved in projects in Jordan, the U.S.A., Morocco, and China. **Turkey** imports more than 90% of its fuel oil and gas and has considered developing its oil shale to reduce that dependence. There are some interesting opportunities (oil shale in one small deposit yields up to 3 barrels of oil per ton), but only a few deposits have been investigated in significant detail. **Morocco** has executed an MOU with Petrobras and Total to evaluate aboveground retorting of oil shale from the Tarfaya and Timhadit deposits and an MOU with San Leon Energy to investigate *in situ* development of portions of Tarfaya. **Syria** exports oil, but production is declining and the country is looking to its gas and oil shale deposits to maintain energy revenues. In 2009, Syria signed an MOU with Jordan to exchange expertise in producing electricity from oil shale. Before the Arab Spring of 2011, **Egypt** was examining the feasibility of developing its oil shale to conserve the country's economically important oil and natural gas. Resource surveys and limited field exploration studies are underway in **Canada, Thailand**, and other places. The Holcim Cement plant in Dotternhausen, **Germany**, continues to make cement from oil shale. Tests continue on the alum oil shale in **Sweden** to determine feasibility of recovering oil, uranium, nickel, molybdenum, and vanadium.

Significance for Oil Shale Development in the USA

Oil shale activities in other countries are very relevant to the future of an oil shale industry in the United States. Like the U.S., nearly all of the other countries that are working on oil shale consume much more oil than they produce. A few (Jordan, Morocco, Turkey) have essentially no indigenous liquid fuel production and are totally dependent on imports, with the attendant economic dislocations and security concerns. Many have sensitive physical environments that could be damaged by poorly controlled and inadequately regulated mining and processing facilities. Many are water-poor and cannot divert water to supply oil shale plants and their associated populations without depriving other people and activities, especially agriculture. Many have small populations and economies and would have difficulty raising billions of dollars to pay for integrated oil shale plants, despite their potential economic benefits in the long term.

Oil shale projects in other countries are also relevant to the U.S. because they will advance understanding of the processing technologies and reduce risks associated with their deployment. A very important benefit of the projects will be validation of high-level engineering designs and cost estimates. Although plants in the current and proposed industries are relatively small compared with what might be supported by the Green River oil shales, they are large enough to address many of the unknowns that must be confronted by promoters of a commercial industry. This is especially important for the retorting facilities, which are expensive to build and operate. In 2006, China's Fushun Mining Group estimated it cost $18.46 to deliver a barrel of shale oil, with 75% of the cost associated with retorting, 23% with transportation, and less than 1% with mining. A failed retort could bring an entire plant down, and it could be very expensive to repair or replace.

The growing body of operating experience and information will greatly reduce the risks associated with a commercialization phase. This progress will facilitate financing and permitting of a facility, which will ultimately mean lower product costs. These advancements are important regardless of where oil shale technology is deployed next, and especially if it is deployed in the U.S.A.

In short, the challenges faced by oil shale proponents in other countries are similar to those encountered in the United States: how to develop a practical, efficient, beneficial industry while protecting the environment and avoiding unacceptable social dislocations. It hasn't been easy over there; it won't be easy here.

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September 17, 2011

Mr. Tim Charters, Staff Director
Subcommittee on Energy & Mineral Resources
1324 Longworth House Office Building
Washington, DC 20515

Dear Mr. Charters:

I appeared before the Subcommittee's oversight hearing on "American Jobs and Energy Security: Domestic Oil Shale the Status of Research, Regulation and Roadblocks" which was held in Grand Junction, Colorado, on August 24. On September 9, Representative Lamborn asked me, as a followup question, "Is there any more information on the important subject of rare earth elements in oil shale that was not discussed at the hearing?" This is my response.

The rare earth elements (REEs) constitute 17 elements in the periodic table: the 15 members of the lanthanide series—lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, terbium, thulium, ytterbium, lutetium—plus the elements scandium and yttrium. Many of the rare earths are important industrial materials. They are used as colorants and oxidizers and in lasers; batteries; permanent magnets; catalytic converters in automobiles; phosphors in televisions, monitors, lighting, and radar; metallurgical alloys; glass; catalysts for chemical production and petroleum refining; and medical technology such as X-ray, MRI, NMR, and PET. They have essential roles to play in the deployment of renewable energy technologies, especially wind and solar. Advanced storage batteries made with REEs help make electric cars more practical.

REEs are a current concern because they are no longer produced in the United States. China is the principal supplier worldwide, and the reliability of the supply is uncertain. Interruptions could cause serious problems for numerous U.S. manufacturers.

Few of the REEs are actually "rare" as such. The average abundance of cerium, for example, is about the same as for copper, and all of the REEs except promethium are much more abundant than gold or silver. However the REEs are dispersed through the earth's crust and are seldom concentrated in easily exploitable deposits, as is often the case with other metals, including copper, gold, and silver. The rare earths are easy to find, because they are occur nearly everywhere. However they are hard to extract, because they are so diffuse, which makes them expensive. A pound of high-purity scandium, for example, currently sells for nearly $7,000.

If some of the REEs were relatively abundant in the oil shale, their recovery as co-products with shale oil might make an oil shale project more economically attractive. With that possibility in mind, I examined a report on trace elements in the oil shale of Colorado's Piceance Basin that was prepared in 1981 for USEPA by Lawrence Berkeley Laboratory and USDOE's Laramie Energy Technology Center. Results are summarized in the attached table, which compares the maximum REE concentrations measured in the oil shale with average concentrations in the earth's upper crust.

Not all the REEs were assayed in the oil shale. Of those that were assayed, cerium is the only element with a higher concentration in the oil shale than in the crust, and that margin is only about 15%. Concentrations of the other rare earths are similar to concentrations reported for average rocks. These findings do not suggest the existence of a rare-earth bonanza in Colorado oil shale.

I hope this very limited study will help you in your work. Please contact me if I can be of further assistance to you or your associates.

Sincerely,

Thomas A. Sladek, PhD

Concentrations of Rare Earth Elements, parts per million by weight

Element	Symbol	Colorado Oil Shale *	Earth's Crust **	Principal Uses
Scandium	Sc	12	26	Alloys, mercury-vapor lamps
Yttrium	Y	28	29	Lasers, phosphors, superconductors
Lanthanum	La	34	34	Glass, flint, batteries, lenses, catalysts
Cerium	Ce	69	60	Oxidizers, polishes, colorants, catalysts
Praseodymium	Pr	--	8.7	Magnets, lasers, arc lights, colorants
Neodymium	Nd	30	33	Magnets, lasers, colorants, capacitors
Promethium	Pm	--	--	Nuclear batteries
Samarium	Sm	5.3	6	Magnets, lasers, masers
Europium	Eu	1.1	1.8	Lasers, mercury-vapor lamps, NMR
Gadolinium	Gd	--	5.2	Magnets, lasers, x-ray tubes, MRI, NMR
Terbium	Tb	0.73	0.94	Phosphors, lasers, lamps
Dysprosium	Dy	4.9	6.2	Magnets, lasers
Holmium	Ho	--	1.2	Lasers
Erbium	Er	--	3.0	Lasers, vanadium steel alloys
Thulium	Tm	--	0.45	X-ray machines
Ytterbium	Yb	2.6	2.8	Lasers, chemical reducers
Lutetium	Lu	0.36	0.56	PET Scan detectors, glass

* Calculated from data in *Characterization of Two Core Holes from the Naval Oil Shale Reserve Number 1* by R.D. Giaque, J.P. Fox, and J.W. Smith. USEPA Report 600/7-81-024, January 1981. Maxima for two core holes.

** Estimates of the average composition of rocks in the continental crust. From *WebElements.com*

Mr. LAMBORN. All right. I am sure we will have some questions shortly.

Thank you.

Ms. Spinti? Professor Spinti?

STATEMENT OF JENNIFER SPINTI, RESEARCH ASSOCIATE PROFESSOR, DEPARTMENT OF CHEMICAL ENGINEERING AND INSTITUTE FOR CLEAN AND SECURE ENERGY, UNIVERSITY OF UTAH

Ms. SPINTI. Yes, Chairman Lamborn, Congressman Tipton, thank you for this opportunity.

I am here representing the Institute for Clean and Secure Energy at the University of Utah. We have had a program in oil shale and sands research for approximately the last 5 years.

I would like to talk about chemical engineering since that is what I am, and in chemical engineering, you first draw a control volume around the problem you want to solve. And that means you are just putting boundaries on the problem.

So, I want to consider a control volume for a wind turbine that sits on a windy ridge. But this control volume doesn't just include the windy ridge, but it includes the mine where the ores are processed that are needed for the wind turbine manufacture. And one of those ores that is needed is neodymium ore. Approximately 1 ton of metal is needed for the manufacture of a 1 megawatt turbine.

Most of that manufacturing, as you indicated, I believe, Congressman Tipton, is occurring in China, where they have very lax

environmental laws. And there are toxic lakes of acidic processing waste right now because of the ore processing that is going on.

We can also consider a control volume around a solar power installation in California. Most of the proposed facilities have involved water cooling, which is a very water-intensive process. You have higher plant efficiency than air cooling, but it requires lots of water.

If you go look at the California Web site where they apply for these or they have applications for these types of facilities, a recently proposed 250 megawatt facility would require 536 million gallons of water per year.

What about mining and water use impacts from oil shale development? Let's draw a control volume that includes these issues. In Utah, the Division of Oil, Gas, and Mining issues permits for oil and gas drilling, coal mining, and minerals.

Oil shale is regulated as a mineral and is subject to minerals regulatory permits. Annual permit fees are required. Operation and reclamation plans must be maintained, and approval must be sought for modification.

As for water, a recent analysis by our institute, a previously published estimate shows an average water consumption rate for oil shale applications that have—where we have public information is 2.5 barrels of water per barrel of shale produced. In order to compare that to the water usage of the solar power plant, we have to convert from energy content to unit of power.

So, I made some assumptions about oil shale's energy content and that you would be burning it in a 30 percent efficiency engine. And that comes out to a 50,000-barrel-a-day oil shale facility, 1.8 million gallons of water per megawatt. That is compared to 2.1 million gallons per megawatt for the solar power plant.

So my question is, is oil shale development orders of magnitude worse than any other kind of development that involves extraction or use of resources on a large scale? There are certainly other issues associated with oil shale development that we can't ignore in our control volume, including the power plant that provides electricity to the oil shale processing plant, the air shed around the facility, the nearby town that will be impacted by development, the endangered species and habitat that will be affected, et cetera.

Do we currently have the information we need to predict with some degree of certainty what will happen in our control volume? I argue yes and no. So we do have quite a bit of information available in the public arena from previous decades of oil shale research, from oil shale booms and busts, and from current international production.

The University of Utah, as I mentioned, has had an oil shale and sands research center that built on several decades of research at the university. We have a report that I brought a copy of for each of you that we published in 2007, assessing some of the technical, economic, and legal issues associated with oil shale and sands production. We have a current research program looking at quite a few issues ranging from policy to economic to technical. I would be happy to discuss those research initiatives with you.

Given all this information, what do we need? We need domestic energy resources to fulfill our domestic needs, and the development of all resources should be held to the same high standards.

We need to move all forms of energy development forward so that we don't miss a solution to the problem. Poor solutions will be eliminated by the market, by the weight of scientific and economic data, or by their failure to meet environmental thresholds set by regulation.

We need a regulatory regime in place that will allow oil shale to stand or fall on its own merits. We need opportunities for oil shale companies to move their technologies up scale from the laboratory to the field, to move from research to application.

We need companies willing to share information with Government, academia, and the general public. Transparency will be the key to success in the arena of public opinion.

We need a multidisciplinary U.S. oil shale research center to address the unforeseen problems—engineering, socioeconomic, environmental, et cetera—that will arise as processes move up scale. Lessons learned at the larger scale can then be used to refine research directions and initiatives.

In conclusion, at the university, we have a couple of models for perhaps moving forward in these arenas. We are working with several oil shale companies, with some simulation tools we have developed, and the idea there is that we want to be able to have quantified predictivity about effects of different technologies.

We also have a lot of public outreach events, conferences that we sponsor that we feel are important to address some of these issues. And the common theme with all of the things that we are doing are collaboration with a wide range of constituencies and data and information sharing. The issues are too large to be discussed and solved in isolation.

Thank you.

[The prepared statement of Ms. Spinti follows:]

Statement of Jennifer P. Spinti, Research Associate Professor, Department of Chemical Engineering, Assistant Director, Clean & Secure Energy from Domestic Oil Shale/Sands Program, Institute for Clean and Secure Energy, The University of Utah

According to the U.S. Environmental Protection Agency, renewable energy comes from sources that "restore themselves over short periods of time and do not diminish" (1). Wind energy is one of the renewable energy sources that the U.S. government has supported through direct spending and tax credits and that states have pushed through renewable energy targets. At the end of 2010, thanks to rapid expansion in capacity, wind power provided 2.3 percent (~40,000 MW of the energy generated in the U.S. (2,3). According to a metals industry analyst, a wind turbine with an electric power generating capacity of 1 MW requires one metric ton of the rare earth metal neodymium for making a permanent magnet (4). That neodymium is most likely mined in Inner Mongolia, a region in China with more than 90 percent of the world's reserves. One of China's most polluted cities, Batou, is located in this region adjacent to a 5-mile wide lake of toxic waste containing acids, heavy metals, and other chemicals left over from the processing of the neodymium ore (5). Studies show high rates of cancer, osteoporosis and skin and respiratory diseases in villages around the lake (5). Does the legacy of this environmental impact diminish the status of "renewable" for wind power?

Another renewable energy source, concentrated solar power, can come with a high price tag for water. Wet cooling, where water is evaporated to remove excess heat, is preferred by developers. Dry cooling, where fans and heat exchangers are used for heat removal, consumes about 90 percent less water but reduces plant efficiency, thus reducing profitability (6). The California Energy Commission has received nu-

merous applications for large-scale solar energy projects in California, and many have large water requirements due to their use of wet cooling technology (7). For example, the Genesis Solar Energy Project would consume an estimated 536 million gallons of water a year for power plant cooling, process water makeup, mirror washing, etc. to produce 250 MW of electricity (8), a rate of 2.1 million gallons of water per megawatt of power generated by this renewable energy source. Is this a sustainable level of water consumption in the arid southwestern deserts where concentrated solar plants are targeted for development?

What about mining and water use impacts from oil shale development? In Utah, the Division of Oil, Gas, and Mining (DOGM) issues permits for oil and gas drilling, coal mining, and minerals mining using guidelines established in the Utah Oil and Gas Conservation Act, the Utah Mined Land Reclamation Act, and the Utah Coal Mining and Reclamation Act (9). Oil shale is regulated as a mineral and is subject to minerals regulatory permits. A large mine, defined as greater than 10 acres, requires a 50+ page application that includes detailed calculations for the bond based upon specific operations. In addition, annual permit fees are required, operation and reclamation plans must be maintained, and approval must be sought for modification (9).

DOGM currently oversees 670 permitted mines in the state of Utah (10). Coal, oil sands, and oil shale mines are particularly controversial. In 2010, after a lengthy appeals process, DOGM issued a permanent program permit to a new surface coal mine, the Coal Hollow Mine, which allows 635 acres of surface disturbance. Earth Energy Resources has applied for a permit to mine 213 acres of oil sands. That permit is currently in appeal (9). Red Leaf Resources is in the process of applying for a large mine permit for development of its oil shale resources.

It is unclear what water consumption rates for oil shale development will be. A recent analysis of previously published estimates shows an average water consumption rate of 2.5 barrels of water per barrel of oil produced (11). An ethanol plant requires four barrels of water to produce one barrel of ethanol, and this amount does not include the water needed for the cultivation of corn (12). How does water usage for oil shale compare to that for the solar energy plant? The energy content of a barrel of oil is measured in units of energy while power plant output is reported in units of power. To compare the two, one must make several assumptions. If one assumes the energy content of a barrel of shale oil to be approximately 1.7 MWh (13) and that it is burned in an engine that has an efficiency of 30 percent, then a 50,000 barrels per day oil shale operation would produce a power equivalent of approximately 1060 MW. At 2.5 barrels of makeup water required per barrel of oil produced, yearly water consumption would be in the 1,900 million gallon range, or 1.8 million gallons of water per megawatt of power produced.

Is oil shale development orders of magnitude worse than any other kind of development that involves extraction or use of resources on a large scale? The above paragraphs address two common critiques used to single out oil shale development, e.g. land disturbance and water usage. There are also critiques related to energy usage, air quality, carbon footprint, capital cost, socioeconomic impacts, etc. All of these concerns are valid given the potential scale of oil shale development in the Uinta and Piceance Basins of Utah and Colorado (see Figure 1). However, there is currently a dearth of data on which to base projections for large-scale impacts because the last active U.S. oil shale facility, the Union Oil operation located in Parachute, CO, was shut down in 1991 (14), and the current round of Research, Development, and Demonstration (RD&D) leases has yet to provide publicly available information on the economic feasibility of various oil shale extraction technologies.

What information on oil shale development and its impacts do we have in the public arena? We have reports and papers from decades of research by academia, national laboratories, companies, and other entities, the experience of oil shale companies currently producing in other countries, and the lessons learned from previous oil shale booms.

The University of Utah has been a contributor to this body of knowledge for many years, beginning with the work of Professor H. Y. Sohn during the oil shale boom of the 1970s and early 1980s and continuing with contributions from Professor J. D. Miller, Dr. James Bunger, and Professor M. D. Deo. In late 2005, the Institute for Clean and Secure Energy (ICSE) at the University of Utah announced the creation of the Utah Heavy Oil Program (UHOP). UHOP's original mission was to provide research support to federal and state constituents for addressing the wide-ranging issues surrounding the creation of an industry for oil shale, oil sands and heavy oil production in the U.S. The scope of the mission was later reduced to focus exclusively on oil shale and oil sands production. The research sponsored by UHOP was broad and interdisciplinary in nature, involving researchers from the Colleges of Engineering, Science, Law, and Business. Funding for UHOP came as the result of a

Congressionally Directed Program; the FY2006 budget was $1.8 million. At the time it was funded, there had been no federal support for oil shale/sands research for well over a decade. Part of the renewed interest in oil shale and oil sands was the passage of the Energy Policy Act of 2005 (EPAct 2005).

UHOP was given two directives in EPAct 2005. The first was to prepare an update to the 1988 technical and economic assessment of domestic heavy oil resources (15) and to the 1996 Department of Energy feasibility study of heavy oil recovery (16). UHOP published "A Technical, Economic, and Legal Assessment of North American Heavy Oil, Oil Sands, and Oil Shale Resources" in 2007. This report evaluated the size of the North American unconventional fuel resource, the production technologies available, the upgrading and refining steps needed, and the economic, social, legal, and environmental issues related to unconventional fuels production (17). The second directive was to sponsor research that related to the objective of Section 369 of EPAct 2005. Four of the sponsored projects were directly related to oil shale and included reservoir modeling for in situ production of oil shale, oil shale pyrolysis kinetics, a analysis of how a federal oil shale program might be implemented, water usage estimates for oil shale development in Utah's Uinta Basin, and produced water treatment options. A final report was submitted to the Department of Energy (DOE) in early 2010 (18).

ICSE received additional funding in FY2008, FY2009, and FY2010 for the Clean and Secure Energy from Domestic Oil Shale and Oil Sands Resources Program. Current research initiatives include the simulation of a modified in situ production process, the development of improved models for kerogen pyrolysis, the development of a predictive geologic model for the Uinta Basin, an analysis of the geomechanical reservoir state (including subsidence issues associated with in situ production), basin scale simulation of the economic and environmental impacts of oil shale development, and conjunctive management of surface water and groundwater resources in Utah. An economic assessment of various oil shale and oil sands development scenarios in Utah's Uinta Basin is also being prepared for publication this fall.

Given that we have all this information, what do we need? We need domestic energy resources to fulfill our domestic needs, and the development of all resources should be held to the same high standards. If we don't like the tailings ponds and open pit oil sands mines in Alberta or the toxic wastes generated by rare earth mines in China for wind turbine components, we need domestic development adherent to more stringent U.S. environmental laws. We need to move all forms of energy development forward so that we don't miss a solution to the problem. Poor solutions will be eliminated by the market, by the weight of scientific and economic data, or by their failure to meet environmental thresholds set by regulation. We need a regulatory regime in place that will allow oil shale to stand or fall on its own merits. For example, oil shale development is and should be held to the same standard as all other types of mining operations in the state of Utah. It should not be singled out for approval or disapproval just because of the resource type that is being mined. We need opportunities for companies to move their technologies upscale. As a 2005 Rand report on oil shale development notes, "Reliable estimates of water requirements will not be available until the technology reaches the scale-up and confirmation stage" (19). We need companies willing to share information with government and academia. It is difficult to employ tools such as high performance computing that could lead to more rapid deployment of technologies without data for validation and uncertainty quantification. We need a multidisciplinary U.S. oil shale research center. Unforeseen problems will arise, and additional research will be required to address those problems. All of those problems will not have an engineering solution, so such a research center will require experts in the fields of policy, environmental science, law, and economics in addition to engineering and science. Finally, we need research to be moved out of the laboratory and/or the policy think tank and into application. Lessons learned at the larger scale can then be used to refine research directions and initiatives.

ICSE has several models for moving forward with respect to the engineering, policy/legal, and economic sides of oil shale development. On the engineering side, ICSE has partnered with several oil shale technology companies to produce simulation tools with quantified predictivity that can be used by industry to assist in the assessment of the technological, economic and environmental consequences of the production of new gas and liquid fuels from U.S. oil shale/sands deposits. The first model is the application of the simulation tools to Red Leaf Resources' patented EcoShale process. In this model, Red Leaf is providing temperature data so that the thermal heating of oil shale can be evaluated. The simulation tools will also be used to study product yield as a function of operating conditions for indirectly heated, rubblized oil shale beds.

The second model is a capstone project that is intended to draw together the results of many years of ICSE research to demonstrate computational simulation capability for the assessment and deployment of the shale oil production process commercialized by American Shale Oil, LLC (AMSO). In this integrated project, we are coupling simulation capabilities with experimental data from key small-scale experiments in a formal validation process where the controlling uncertainties are accounted for and quantified. Our goal is to demonstrate that optimal risk assessment and decision-making regarding deployment of this new technology is most efficiently accomplished by this formal validation and uncertainty quantification process. In this model, AMSO is providing funding for the small-scale experiments.

The third model is a joint research project with Los Alamos National Laboratory (LANL) to develop a predictive tool for assessing the basin- or regional-scale environmental and economic impacts of unconventional fuel development. LANL developed a dynamic, integrated assessment tool several years ago that is being updated, improved, and subjected to a rigorous validation and uncertainty quantification process through the cooperative efforts of ICSE and LANL researchers.

On the policy/legal side, ICSE is collaborating with the Wallace Stegner Center for Land, Resources, and the Environment at the University of Utah. Professor Robert Keiter, the director of the Stegner Center, is also the Associate Director of ICSE for Legal and Policy. Together, ICSE and the Stener Center have hosted the Energy Forum the past two years. The Energy Forum 2011 will feature former U.S. Senator Bob Bennett and former Wyoming Governor Dave Freudenthal in a panel discussion of energy policy challenges including climate change, regional energy demand, natural resources, and national energy security.

Outreach efforts by ICSE also include hosting the annual University of Utah Unconventional Fuels Conference. This year's conference featured speakers from the Bureau of Land Management Office in Washington, D.C., a member of the Ute Tribe whose lands encompass significant conventional and unconventional fuel resources, representatives from AMSO, Red Leaf, and Enefit, and the director of the Division of Oil, Gas, and Mining for the state of Utah. ICSE has also teamed with the Utah Geological Survey and the Bingham Entreprenseurship and Energy Research Center in Vernal, UT, to lead field trips to oil shale and sands sites in the Uinta Basin.

I will be happy to answer any questions you might have about specific research results, overall program directions, or information contained in our reports at the hearing.

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Figures

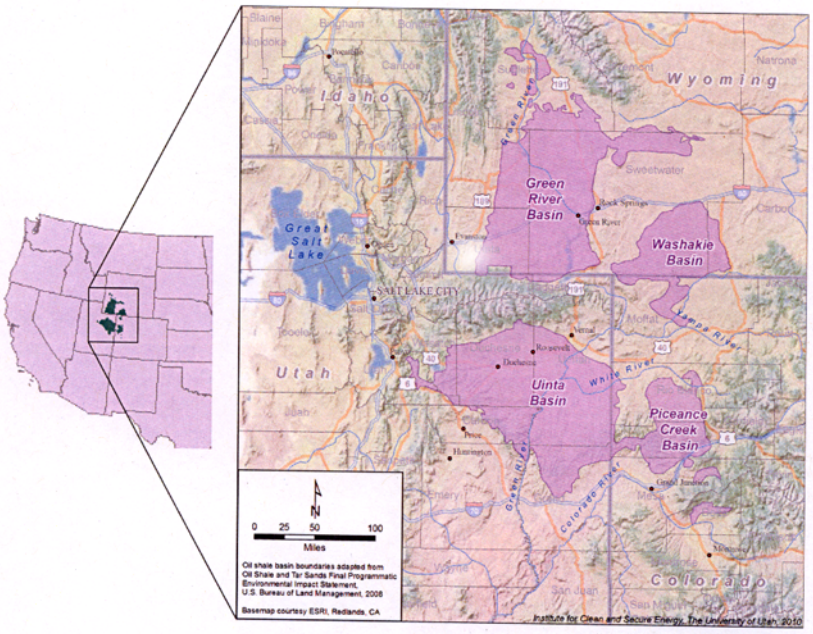


Figure 1: Location of Green River Formation showing main basins in purple.

Mr. LAMBORN. All right, thank you.

Ms. Mittal?

STATEMENT OF ANU MITTAL, DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT DIVISION, GOVERNMENT ACCOUNTABILITY OFFICE

Ms. MITTAL. Chairman Lamborn and Congressman Tipton, I am pleased to be here today to participate in your field hearing on oil shale development.

As you know, interest in developing a domestic oil shale industry can be traced back to the early 1900s. However, the industry has been hampered by technological challenges, average oil prices that have been too low to consistently justify investment in this resource, and concerns about the potential impacts on the environment.

In October 2010, GAO issued a report that focused on one area of particular concern—the amount of water that could be needed to develop an oil shale industry. My testimony today will summarize the findings of that report and focus on what is known about the potential impacts of oil shale development on water resources, what is known about the amount of water that may be needed for the commercial development of oil shale, the extent to which water could be a potential limiting factor in the industry's development, and the need for Federal research efforts to help mitigate these potential impacts.

First, we found that oil shale development could have significant impacts on the quantity and quality of water resources in Colorado and Utah, but the magnitude of these impacts is largely unknown. This is because the technologies that would be used have not yet been commercially proven, the size of the future oil shale industry is currently uncertain, and there is limited knowledge of current water conditions and groundwater flows in the area.

While it is difficult to definitively determine the quantitative impacts of oil shale development on water resources, it is possible to identify the potential qualitative impacts of this development. For example, oil shale development could impact water quality through surface disturbances from the construction of roads and production facilities.

Water quality could also be impacted by large water withdrawals from streams and aquifers and from discharges of contaminants through operations. It will, therefore, be critical for the industry to implement effective measures to mitigate these potential impacts.

With regard to the amount of water that could be needed to develop a commercial oil shale industry, we found that the estimates varied widely, depending on the characteristics of the processes used. We also found that there is greater uncertainty in how much water could be needed by an in-situ operation versus a surface retorting operation.

Nonetheless, it is expected that the average total water needs for the entire oil shale production life cycle could be about three barrels of water for each barrel of oil produced for surface retorting operations and five barrels for in-situ operations. Most of the companies that we contacted said that they are looking for ways to reduce their water use, for example, by reusing or recycling water at their operations.

We also found that while the amount of water needed for the initial development of an oil shale industry is most likely available,

the growth of the industry may be limited by a number of factors that could impact future water availability. Most of the companies we contacted were confident that they held enough water rights for their initial shale development projects, and they would most likely be able to purchase more rights in the future as needed.

However, these companies could face challenges in acquiring additional water rights in the future because of expected increases in water demands from municipal and industrial users in these areas, because of potential reductions in water supplies from a warming climate, and because of greater need for water to fulfill interstate compact obligations and protect endangered species.

Finally, since 2006, the Federal Government had spent over $22 million on oil shale development research, and only about $5 million of this amount was spent to study water-related issues. However, most Government officials and water experts that we spoke to agree that there are insufficient data on the baseline conditions of water resources in the oil shale regions of Colorado and Utah and that additional research is needed to understand the movement of groundwater and its interaction with surface water.

We also found that Federal officials at DOE and Interior seldom coordinate their water-related oil shale research with each other or with State water officials. As a result of these findings, we made three recommendations to Interior to proactively begin preparing for the potential impacts of a future oil shale industry. Interior generally concurred with our recommendations and noted that it has and will continue to take actions to implement them.

In conclusion, Mr. Chairman, for nearly a century, industry, with some Government support, has focused on overcoming the technological challenges of developing a commercially viable oil shale industry. However, there are a number of other associated impacts that should not be overlooked, and now is the time for Federal agencies to proactively begin focusing on these issues.

This concludes my prepared statement. I would be happy to answer any questions.

[The prepared statement of Ms. Mittal follows:]

Statement of Anu K. Mittal, Director, Natural Resources and Environment Team, United States Government Accountability Office

Chairman Lamborn, Ranking Member Holt, and Members of the Subcommittee:

I am pleased to be here today to participate in your field hearing on oil shale development. As you know, being able to tap the vast amounts of oil locked within U.S. oil shale could go a long way toward satisfying our nation's future oil demands. The Green River Formation—an assemblage of over 1,000 feet of sedimentary rocks that lie beneath parts of Colorado, Utah, and Wyoming—contains the world's largest deposits of oil shale. The U.S. Geological Survey (USGS) estimates that the Green River Formation contains about 3 trillion barrels of oil and that about half of this may be recoverable, depending on available technology and economic conditions. This is an amount about equal to the entire world's proven oil reserves. The thickest and richest oil shale within the Green River Formation exists in the Piceance Basin of northwest Colorado and the Uintah Basin of northeast Utah (see app. I). The federal government is in a unique position to influence the development of oil shale because 72 percent of the oil shale within the Green River Formation is beneath federal lands managed by the Department of the Interior's (Interior) Bureau of Land Management (BLM). The Department of Energy (DOE) has provided technological and financial support for oil shale development through its research and development efforts, but oil shale development has been hampered by technological challenges, average oil prices that have been too low to consistently justify investment, and concerns over potential impacts on the environment.

One area of particular concern is that developing oil shale will require large amounts of water—a resource that is already in scarce supply in the arid West where an expanding population is placing additional demands on water. Some analysts project that large scale oil shale development within Colorado could require more water than is currently supplied to over 1 million residents of the Denver metro area and that water diverted for oil shale operations would restrict agricultural and urban development. The potential demand for water is further complicated by the past decade of drought in the West and projections of a warming climate in the future. In October 2010, we issued a report that examined the nexus between oil shale development and water impacts.[1]

My testimony today will summarize the findings of that report. Specifically, I will discuss (1) what is known about the potential impacts of oil shale development on surface water and groundwater, (2) what is known about the amount of water that may be needed for the commercial development of oil shale, (3) the extent to which water will likely be available for commercial oil shale development and its source, and (4) federal research efforts to address impacts on water resources from commercial oil shale development. To perform this work we, among other things, reviewed an environmental impact statement on oil shale development prepared by BLM and various studies from private and public groups; we also interviewed officials at DOE, USGS, BLM; state regulatory agencies in Colorado and Utah; oil shale industry representatives; water experts; and organizations performing research, including universities and national laboratories, and reviewed relevant documents describing their research. We conducted this work in accordance with generally accepted government auditing standards.

Background

Interest in oil shale as a domestic energy source has waxed and waned since the early 1900s. More recently, the Energy Policy Act of 2005 directed BLM to lease its lands for oil shale research and development. In June 2005, BLM initiated a leasing program for research, development, and demonstration (RD&D) of oil shale recovery technologies. By early 2007, it granted six small RD&D leases: five in the Piceance Basin of northwest Colorado and one in Uintah Basin of northeast Utah. The leases are for a 10-year period, and if the technologies are proven commercially viable, the lessees can significantly expand the size of the leases for commercial production into adjacent areas known as preference right lease areas. The Energy Policy Act of 2005 also directed BLM to develop a programmatic environmental impact statement (PEIS) for a commercial oil shale leasing program. During the drafting of the PEIS, however, BLM realized that, without proven commercial technologies, it could not adequately assess the environmental impacts of oil shale development and dropped from consideration the decision to offer additional specific parcels for lease. Instead, the PEIS analyzed making lands available for potential leasing and allowing industry to express interest in lands to be leased. Environmental groups then filed lawsuits, challenging various aspects of the PEIS and the RD&D program. Since then, BLM has initiated another round of oil shale RD&D leasing.

Stakeholders in the future development of oil shale are numerous and include the federal government, state government agencies, the oil shale industry, academic institutions, environmental groups, and private citizens. Among federal agencies, BLM manages the land and the oil shale beneath it and develops regulations for its development. USGS describes the nature and extent of oil shale deposits and collects and disseminates information on the nation's water resources. DOE, through its various offices, national laboratories, and arrangements with universities, advances energy technologies, including oil shale technology. The Environmental Protection Agency (EPA) sets standards for pollutants that could be released by oil shale development and reviews environmental impact statements, such as the PEIS. Interior's Bureau of Reclamation (BOR) manages federally built water projects that store and distribute water in 17 western states and provides this water to users. BOR monitors the amount of water in storage and the amount of water flowing in the major streams and rivers, including the Colorado River, which flows through oil shale country and feeds these projects. BOR provides its monitoring data to federal and state agencies that are parties to three major federal, state, and international agreements that together with other federal laws, court decisions, and agreements, gov-

[1] GAO, Energy-Water Nexus: A Better and Coordinated Understanding of Water Resources Could Help Mitigate the Impacts of Potential Oil Shale Development, GAO-11-35 (Washington, D.C.; Oct. 29, 2010).

ern how water within the Colorado River and its tributaries is to be shared with Mexico and among the states in which the river or its tributaries are located.[2]

The states of Colorado and Utah have regulatory responsibilities over various activities that occur during oil shale development, including activities that impact water. Through authority delegated by EPA under the Clean Water Act, Colorado and Utah regulate discharges into surface waters. Colorado and Utah also have authority over the use of most water resources within their respective state boundaries. They have established extensive legal and administrative systems for the orderly use of water resources, granting water rights to individuals and groups. Water rights in these states are not automatically attached to the land upon which the water is located. Instead, companies or individuals must apply to the state for a water right and specify the amount of water to be used, its intended use, and the specific point from where the water will be diverted for use, such as a specific point on a river or stream. Utah approves the application for a water right through an administrative process, and Colorado approves the application for a water right through a court proceeding. The date of the application establishes its priority—earlier applicants have preferential entitlement to water over later applicants if water availability decreases during a drought. These earlier applicants are said to have senior water rights. When an applicant puts a water right to beneficial use, it is referred to as an absolute water right. Until the water is used, however, the applicant is said to have a conditional water right. Even if the applicant has not yet put the water to use, such as when the applicant is waiting on the construction of a reservoir, the date of the application still establishes priority. Water rights in both Colorado and Utah can be bought and sold, and strong demand for water in these western states facilitates their sale.

A significant challenge to the development of oil shale lies in the current technology to economically extract oil from oil shale. To extract the oil, the rock needs to be heated to very high temperatures—ranging from about 650 to 1,000 degrees Fahrenheit—in a process known as retorting. Retorting can be accomplished primarily by two methods. One method involves mining the oil shale, bringing it to the surface, and heating it in a vessel known as a retort. Mining oil shale and retorting it has been demonstrated in the United States and is currently done to a limited extent in Estonia, China, and Brazil. However, a commercial mining operation with surface retorts has never been developed in the United States because the oil it produces competes directly with conventional crude oil, which historically has been less expensive to produce. The other method, known as an in-situ process, involves drilling holes into the oil shale, inserting heaters to heat the rock, and then collecting the oil as it is freed from the rock. Some in-situ technologies have been demonstrated on very small scales, but other technologies have yet to be proven, and none has been shown to be economically or environmentally viable.

Nevertheless, according to some energy experts, the key to developing our country's oil shale is the development of an in-situ process because most of the richest oil shale is buried beneath hundreds to thousands of feet of rock, making mining difficult or impossible. Additional economic challenges include transporting the oil produced from oil shale to refineries because pipelines and major highways are not prolific in the remote areas where the oil shale is located, and the large-scale infrastructure that would be needed to supply power to heat oil shale is lacking. In addition, average crude oil prices have been lower than the threshold necessary to make oil shale development profitable over time.

Large-scale oil shale development also brings socioeconomic impacts. There are obvious positive impacts such as the creation of jobs, increase in wealth, and tax and royalty payments to governments, but there are also negative impacts to local communities. Oil shale development can bring a sizeable influx of workers, who along with their families, put additional stress on local infrastructure such as roads, housing, municipal water systems, and schools. Development from expansion of extractive industries, such as oil shale or oil and gas, has typically followed a "boom and bust" cycle in the West, making planning for growth difficult. Furthermore, traditional rural uses could be replaced by the industrial development of the landscape, and tourism that relies on natural resources, such as hunting, fishing, and wildlife viewing, could be negatively impacted.

Developing oil shale resources also faces significant environmental challenges. For example, construction and mining activities can temporarily degrade air quality in local areas. There can also be long-term regional increases in air pollutants from oil shale processing, upgrading, pipelines, and the generation of additional electricity. Pollutants, such as dust, nitrogen oxides, and sulfur dioxide, can contribute

[2] These three major agreements are the Colorado River Compact of 1922, the Upper Colorado River Basin Compact of 1948, and the Mexican Water Treaty of 1944.

to the formation of regional haze that can affect adjacent wilderness areas, national parks, and national monuments, which can have very strict air quality standards. Because oil shale operations clear large surface areas of topsoil and vegetation, some wildlife habitat will be lost. Important species likely to be negatively impacted from loss of wildlife habitat include mule deer, elk, sage grouse, and raptors. Noise from oil shale operations, access roads, transmission lines, and pipelines can further disturb wildlife and fragment their habitat. Environmental impacts could be compounded by the impacts of coal mining, construction, and extensive oil and gas development in the area. Air quality and wildlife habitat appear to be particularly susceptible to the cumulative effect of these impacts, and according to some environmental experts, air quality impacts may be the limiting factor for the development of a large oil shale industry in the future. Lastly, the withdrawal of large quantities of surface water for oil shale operations could negatively impact aquatic life downstream of the oil shale development. My testimony today will discuss impacts to water resources in more detail.

Oil Shale Development Could Adversely Impact Water Resources, but the Magnitude of These Impacts Is Unknown

In our October report, we found that oil shale development could have significant impacts on the quantity and quality of surface and groundwater resources, but the magnitude of these impacts is unknown. For example, we found that it is not possible to quantify impacts on water resources with reasonable certainty because it is not yet possible to predict how large an oil shale industry may develop. The size of the industry would have a direct relationship to water impacts. We noted that, according to BLM, the level and degree of the potential impacts of oil shale development cannot be quantified because this would require making many speculative assumptions regarding the potential of the oil shale, unproven technologies, project size, and production levels.

Hydrologists and engineers, while not able to quantify the impacts from oil shale development, have been able to determine the qualitative nature of its impacts because other types of mining, construction, and oil and gas development cause disturbances similar to impacts that would be expected from oil shale development. According to these experts, in the absence of effective mitigation measures, impacts from oil shale development to water resources could result from disturbing the ground surface during the construction of roads and production facilities, withdrawing water from streams and aquifers for oil shale operations, underground mining and extraction, and discharging waste waters from oil shale operations. For example, we reported that oil shale operations need water for a number of activities, including mining, constructing facilities, drilling wells, generating electricity for operations, and reclamation of disturbed sites. Water for most of these activities is likely to come from nearby streams and rivers because it is more easily accessible and less costly to obtain than groundwater. Withdrawing water from streams and rivers would decrease flows downstream and could temporarily degrade downstream water quality by depositing sediment within the stream channels as flows decrease. The resulting decrease in water would also make the stream or river more susceptible to temperature changes—increases in the summer and decreases in the winter. These elevated temperatures could have adverse impacts on aquatic life, which need specific temperatures for proper reproduction and development and could also decrease dissolved oxygen, which is needed by aquatic animals.

We also reported that both underground mining and in-situ operations would permanently impact aquifers. For example, underground mining would permanently alter the properties of the zones that are mined, thereby affecting groundwater flow through these zones. The process of removing oil shale from underground mines would create large tunnels from which water would need to be removed during mining operations. The removal of this water through pumping would decrease water levels in shallow aquifers and decrease flows to streams and springs that are connected. When mining operations cease, the tunnels would most likely be filled with waste rock, which would have a higher degree of porosity and permeability than the original oil shale that was removed. Groundwater flow through this material would increase permanently, and the direction and pattern of flows could change permanently. Similarly, in-situ extraction would also permanently alter aquifers because it would heat the rock to temperatures that transform the solid organic compounds within the rock into liquid hydrocarbons and gas that would fracture the rock upon escape. The long-term effects of groundwater flows through these retorted zones are unknown. Some in-situ operations envision using a barrier to isolate thick zones of oil shale with intervening aquifers from any adjacent aquifers and pumping out all the groundwater from this isolated area before retorting.

The discharge of waste waters from operations would also temporarily increase water flows in receiving streams. These discharges could also decrease the quality of downstream water if the discharged water is of lower quality, has a higher temperature, or contains less oxygen. Lower-quality water containing toxic substances could increase fish and invertebrate mortality. Also, increased flow into receiving streams could cause downstream erosion. However, if companies recycle waste water and water produced during operations, these discharges and their impacts could be substantially reduced.

Estimates of Water Needs for Commercial Oil Shale Development Vary Widely

Commercial oil shale development requires water for numerous activities throughout its life cycle; however, we found that estimates vary widely for the amount of water needed to produce oil shale. These variations stem primarily from the uncertainty associated with reclamation technologies for in-situ oil shale development and because of the various ways to generate power for oil shale operations, which use different amounts of water.

In our October report, we stated that water is needed for five distinct groups of activities that occur during the life cycle of oil shale development: (1) extraction and retorting, (2) upgrading of shale oil, (3) reclamation, (4) power generation, and (5) population growth associated with oil shale development. However, we found that few studies that we examined included estimates for the amount of water used by each of these activities. Consequently, we calculated estimates of the minimum, maximum, and average amounts of water that could be needed for each of the five groups of activities that comprise the life cycle of oil shale development. Based on our calculations, we estimated that about 1 to 12 barrels of water could be needed for each barrel of oil produced from in-situ operations, with an average of about 5 barrels (see table 1); and about 2 to 4 barrels of water could be needed for each barrel of oil produced from mining operations with a surface retort operation, with an average of about 3 barrels (see table 2).

Table 1: Estimated Barrels of Water Needed for Various Activities per Barrel of Shale Oil Produced by In-Situ Operations

Activity	Minimum estimate	Average estimate	Maximum estimate
Extraction/retorting	0	0.7	1.0
Upgrading liquids	0.6	0.9	1.6
Power generation	0.1	1.5	3.4
Reclamation	0	1.4	5.5
Population growth	0.1	0.3	0.3
Total	**0.8**	**4.8**	**11.8**

Source: GAO analysis of selected studies.

Notes: GAO used from four to six studies to obtain the numbers for each group of activities. See GAO-11-35 to identify the specific studies. The average for reclamation may be less useful because estimates are either at the bottom or the top of this range.

Table 2: Estimated Barrels of Water Needed for Various Activities per Barrel of Shale Oil Produced by Mining and Surface Retorting

Activity	Minimum estimate	Average estimate	Maximum estimate
Extraction/retorting and upgrading liquids	0.9	1.5	1.9
Power generation	0	0.3	0.9
Reclamation	0.6	0.7	0.8
Population growth	0.3	0.3	0.4
Total	**1.8**	**2.8**	**4.0**

Source: GAO analysis of selected studies.

Note: GAO used from three to six studies to obtain the numbers for each group of activities. See GAO-11-35 to identify the specific studies.

Water Is Likely to Be Available Initially from Local Sources, but the Size of an Oil Shale Industry May Eventually Be Limited by Water Availability

In October 2010, we reported that water is likely to be available for the initial development of an oil shale industry, but the eventual size of the industry may be limited by the availability of water and demands for water to meet other needs. Oil shale companies operating in Colorado and Utah will need to have water rights to develop oil shale, and representatives from all of the companies with whom we spoke were confident that they held at least enough water rights for their initial projects and will likely be able to purchase more rights in the future. According to a study by the Western Resource Advocates, a nonprofit environmental law and policy organization, of water rights ownership in the Colorado and White River Basins of Colorado companies have significant water rights in the area. For example, the study found that Shell owns three conditional water rights for a combined diversion of about 600 cubic feet per second from the White River and one of its tributaries and has conditional rights for the combined storage of about 145,000 acre-feet in two proposed nearby reservoirs.

In addition to exercising existing water rights and agreements, there are other options for companies to obtain more water rights in the future, according to state officials in Colorado and Utah. In Colorado, companies can apply for additional water rights in the Piceance Basin on the Yampa and White Rivers. For example, Shell recently applied—but subsequently withdrew the application—for conditional rights to divert up to 375 cubic feet per second from the Yampa River for storage in a proposed reservoir that would hold up to 45,000 acre-feet for future oil shale development. In Utah, however, officials with the State Engineer's office said that additional water rights are not available, but that if companies want additional rights, they could purchase them from other owners.

Most of the water needed for oil shale development is likely to come first from surface flows, as groundwater is more costly to extract and generally of poorer quality in the Piceance and Uintah Basins. However, companies may use groundwater in the future should they experience difficulties in obtaining rights to surface water. Furthermore, water is likely to come initially from surface sources immediately adjacent to development, such as the White River and its tributaries that flow through the heart of oil shale country in Colorado and Utah, because the cost of pumping water over long distances and rugged terrain would be high, according to water experts.

Developing a sizable oil shale industry may take many years—perhaps 15 or 20 years by some industry and government estimates—and such an industry may have to contend with increased demands for water to meet other needs. For example, substantial population growth and its correlative demand for water are expected in the oil shale regions of Colorado and Utah. State officials expect that the population within the region surrounding the Yampa, White, and Green Rivers in Colorado will triple between 2005 and 2050. These officials expect that this added population and corresponding economic growth by 2030 will increase municipal and industrial demands for water, exclusive of oil shale development, by about 22,000 acre-feet per year, or a 76 percent increase from 2000. Similarly in Utah, state officials expect the population of the Uintah Basin to more than double its 1998 size by 2050 and that correlative municipal and industrial water demands will increase by 7,000 acre-feet per year, or an increase of about 30 percent since the mid-1990s. Municipal officials in two communities adjacent to proposed oil shale development in Colorado said that they were confident of meeting their future municipal and industrial demands from their existing senior water rights and as such will probably not be affected by the water needs of a future oil shale industry. However, large withdrawals could impact agricultural interests and other downstream water users in both states, as oil shale companies may purchase existing irrigation and agricultural rights for their oil shale operations. State water officials in Colorado told us that some holders of senior agricultural rights have already sold their rights to oil shale companies. A future oil shale industry may also need to contend with a general decreased physical supply of water regionwide due to climate change; Colorado's and Utah's obligations under interstate compacts that could further reduce the amount of water available for development; and limitations on withdrawals from the Colorado River system to meet the requirements to protect certain fish species under the Endangered Species Act.

Oil shale companies own rights to a large amount of water in the oil shale regions of Colorado and Utah, but we concluded that there are physical and legal limits on how much water they can ultimately withdraw from the region's waterways, which will limit the eventual size of the overall industry. Physical limits are set by the amount of water that is present in the river, and the legal limit is the sum of the

water that can be legally withdrawn from the river as specified in the water rights held by downstream users. Our analysis of the development of an oil shale industry at Meeker, Colorado, based on the water available in the White River, suggests that there is much more water than is needed to support the water needs for all the sizes of an industry that would rely on mining and surface retorting that we considered. However, if an industry that uses in-situ extraction develops, water could be a limiting factor just by the amount of water physically available in the White River.

Federal Research Efforts on the Impacts of Oil Shale Development on Water Resources Do Not Provide Sufficient Data for Future Monitoring

Since 2006, the federal government has sponsored over $22 million of research on oil shale development and of this amount about $5 million was spent on research related to the nexus between oil shale development and water. Even with this research, we reported that there is a lack of comprehensive data on the condition of surface water and groundwater and their interaction, which limits efforts to monitor and mitigate the future impacts of oil shale development. Currently DOE funds most of the research related to oil shale and water resources, including research on water rights, water needs, and the impacts of oil shale development on water quality. Interior also performs limited research on characterizing surface and groundwater resources in oil shale areas and is planning some limited monitoring of water resources. However, there is general agreement among those we contacted—including state personnel who regulate water resources, federal agency officials responsible for studying water, water researchers, and water experts—that this ongoing research is insufficient to monitor and then subsequently mitigate the potential impacts of oil shale development on water resources. Specifically, they identified the need for additional research in the following areas:

- Comprehensive baseline conditions for surface water and groundwater quality and quantity. Experts we spoke with said that more data are needed on the chemistry of surface water and groundwater, properties of aquifers, age of groundwater, flow rates and patterns of groundwater, and groundwater levels in wells.
- Groundwater movement and its interaction with surface water. Experts we spoke with said that additional research is needed to develop a better understanding of the interactions between groundwater and surface water and of groundwater movement for modeling possible transport of contaminants. In this context, more subsurface imaging and visualization are needed to build geologic and hydrologic models and to study how quickly groundwater migrates. Such tools will aid in monitoring and providing data that does not currently exist.

In addition, we found that DOE and Interior officials seldom formally share the information on their water-related research with each other. USGS officials who conduct water-related research at Interior and DOE officials at the National Energy Technology Laboratory (NETL), which sponsors the majority of the water and oil shale research at DOE, stated they have not talked with each other about such research in almost 3 years. USGS staff noted that although DOE is currently sponsoring most of the water-related research, USGS researchers were unaware of most of these projects. In addition, staff at DOE's Los Alamos National Laboratory who are conducting some water-related research for DOE noted that various researchers are not always aware of studies conducted by others and stated that there needs to be a better mechanism for sharing this research. Based on our review, we found there does not appear to be any formal mechanism for sharing water-related research activities and results among Interior, DOE, and state regulatory agencies in Colorado and Utah. The last general meeting to discuss oil shale research among these agencies was in October 2007, but there have been opportunities to informally share research at the annual Oil Shale Symposium, such as the one that was conducted at the Colorado School of Mines in October 2010. Of the various officials with the federal and state agencies, representatives from research organizations, and water experts we contacted, many noted that federal and state agencies could benefit from collaboration with each other on water-related research involving oil shale. Representatives from NETL stated that collaboration should occur at least every 6 months.

As a result of our findings, we made three recommendations in our October 2010 report to the Secretary of the Interior. Specifically, we stated that to prepare for possible impacts from the future development of oil shale, the Secretary should direct the appropriate managers in the Bureau of Land Management and the U.S. Geological Survey to

- establish comprehensive baseline conditions for groundwater and surface water quality, including their chemistry, and quantity in the Piceance and

Uintah Basins to aid in the future monitoring of impacts from oil shale development in the Green River Formation;

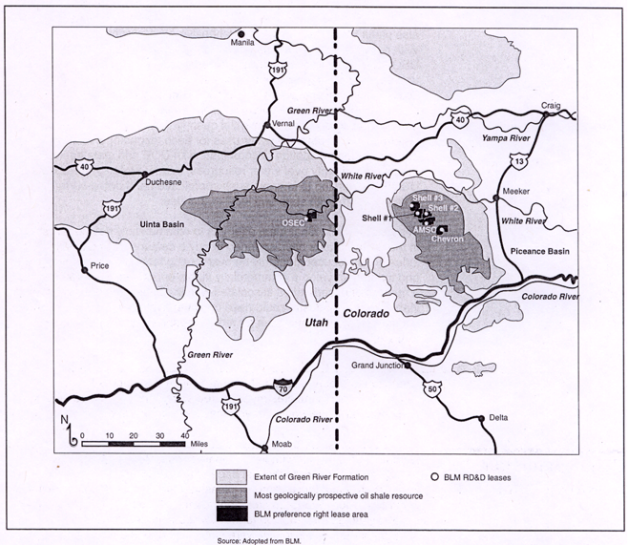
- model regional groundwater movement and the interaction between groundwater and surface water, in light of aquifer properties and the age of groundwater, so as to help in understanding the transport of possible contaminants derived from the development of oil shale; and
- coordinate with the Department of Energy and state agencies with regulatory authority over water resources in implementing these recommendations, and to provide a mechanism for water-related research collaboration and sharing of results.

Interior generally concurred with our recommendations. In response to our first recommendation, Interior commented that there are ongoing USGS efforts to analyze existing water quality data in the Piceance Basin and to monitor surface water quality and quantity in both basins but that it also plans to conduct more comprehensive assessments in the future. With regard to our second recommendation, Interior stated that BLM and USGS are working on identifying shared needs for modeling. Interior underscored the importance of modeling prior to the approval of large-scale oil shale development and cited the importance of the industry's testing of various technologies on federal RD&D leases to determine if production can occur in commercial quantities and to develop an accurate determination of potential water uses for each technology. In support of our third recommendation to coordinate with DOE and state agencies with regulatory authority over water resources, Interior stated that BLM and USGS are working to improve such coordination and noted current ongoing efforts with state and local authorities.

In conclusion, Mr. Chairman, attempts to commercially develop oil shale in the United States have spanned nearly a century. During this time, the industry has focused primarily on overcoming technological challenges and trying to develop a commercially viable operation. However, there are a number of uncertainties associated with the impacts that a commercially viable oil shale industry could have on water availability and quality that should be an important focus for federal agencies and policymakers going forward.

Chairman Lamborn, Ranking Member Holt, and Members of the Committee, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

Appendix I: Location of Oil Shale Resources in Colorado and Utah



Source: Adopted from BLM.

Contact and Staff Acknowledgments

Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this testimony. For further information about this testimony, please contact Anu K. Mittal, Director, Natural Resources and Environment team, (202) 512–3841 or mittala@gao.gov. In addition to the individual named above, key contributors to this testimony were Dan Haas (Assistant Director), Quindi Franco, Alison O'Neill, Barbara Timmerman, and Lisa Vojta.

GAO's Mission

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GAO HIGHLIGHTS

August 24, 2011

ENERGY DEVELOPMENT AND WATER USE
Impacts of Potential Oil Shale Development on Water Resources

Why GAO Did This Study

Oil shale deposits in Colorado, Utah, and Wyoming are estimated to contain up to 3 trillion barrels of oil—or an amount equal to the world's proven oil reserves. About 72 percent of this oil shale is located beneath federal lands managed by the Department of the Interior's Bureau of Land Management, making the federal government a key player in its potential development. Extracting this oil is expected to require substantial amounts of water and could impact groundwater and surface water.

GAO's testimony is based on its October 2010 report on the impacts of oil shale development (GAO–11–35). This testimony summarizes (1) what is known about the potential impacts of oil shale development on surface water and groundwater, (2) what is known about the amount of water that may be needed for commercial oil shale development, (3) the extent to which water will likely be available for such development and its source, and (4) federal research efforts to address impacts to water resources from commercial oil shale development. For its October 2010 report, GAO reviewed studies and interviewed water experts, officials from federal and state agencies, and oil shale industry representatives.

What GAO Found

Oil shale development could have significant impacts on the quality and quantity of water resources, but the magnitude is unknown because technologies are not yet commercially proven, the size of a future industry is uncertain, and knowledge of current water conditions is limited. In the absence of effective mitigation measures, water resources could be impacted by disturbing the ground surface during the construction of roads and production facilities, withdrawing water from streams and aquifers for oil shale operations, underground mining and extraction, and discharging waste waters produced from or used in such operations.

Commercial oil shale development requires water for numerous activities throughout its life cycle, but estimates vary widely for the amount of water needed to commercially produce oil shale primarily because of the unproven nature of some technologies and because the various ways of generating power for operations use differing quantities of water. GAO's review of available studies indicated that the expected total water needs for the entire life cycle of oil shale production range from about 1 barrel (or 42 gallons) to 12 barrels of water per barrel of oil produced from in-situ (underground heating) operations, with an average of about 5 barrels, and from about 2 to 4 barrels of water per barrel of oil produced from mining operations with surface heating, with an average of about 3 barrels.

GAO reported that water is likely to be available for the initial development of an oil shale industry but that the size of an industry in Colorado or Utah may eventually be limited by water availability. Water limitations may arise from increases in water demand from municipal and industrial users, the potential of reduced water supplies from a warming climate, the need to fulfill obligations under interstate water compacts, and decreases on withdrawals from the Colorado River system to meet the requirements to protect threatened and endangered fish species.

The federal government sponsors research on the impacts of oil shale on water resources through the Departments of Energy (DOE) and Interior. Even with this research, nearly all of the officials and experts that GAO contacted said that there are insufficient data to understand baseline conditions of water resources in the oil shale regions of Colorado and Utah and that additional research is needed to understand the movement of groundwater and its interaction with surface water. Federal agency officials also told GAO that they seldom coordinate water-related oil shale research among themselves or with state agencies that regulate water.

In its October report, GAO made three recommendations to the Secretary of the Interior to prepare for the possible impacts of oil shale development, including the establishment of comprehensive baseline conditions for water resources in the oil shale regions of Colorado and Utah, modeling regional groundwater movement, and coordinating on water-related research with DOE and state agencies involved in water regulation. The Department of the Interior generally concurred with the recommendations. GAO is making no new recommendations at this time.

Mr. LAMBORN. All right. Thank you.

Thank each one of you for your good testimony, for the facts that you brought to our attention.

I would now like to recognize myself to begin the first round of questions. Professor Spinti, you gave, I believe, a different estimate of the per barrel use of water for barrel of extracted petrochemicals. Is that correct? I think you said one and a half?

Ms. SPINTI. Equals 2.5 barrels of water per barrel of oil produced. That number is from previously published research. We published that report about a year ago. We did not query the operating companies.

Mr. LAMBORN. OK. Now does that take into account recycling?

Ms. SPINTI. Yes. That is—in chemical engineering terms, that is what we call makeup water. So that is the what we will call water usage per barrel is actually more——

Mr. LAMBORN. Could you speak into the microphone?

Ms. SPINTI. The overall water use is actually more than that, but you are recycling a lot of that. And so, the water that you have to add, the makeup water, is 2.5 barrels per barrel of water.

Mr. LAMBORN. OK. How much of that is direct use versus indirect use? Like if there is a facility that is newly built that brings in water for people to live as a small village, let's say, to me, that would be an indirect use.

Ms. SPINTI. Yes. So that number is only direct use.

Mr. LAMBORN. Direct use. Good.

Ms. SPINTI. That doesn't include the additional water demand from the town and the number of employees that are there.

Mr. LAMBORN. All right, thank you.

Dr. Sladek, what are some of these other countries doing to bring in innovative technology that could be of use here in the United States to reduce the environmental impact of oil shale production?

Dr. SLADEK. Well, one of China's projects is to add a large Canadian retort, which has been tested fairly thoroughly in Australia with some disappointing results. So the developers of that technology are familiar with the environmental consequences of doing things unwisely. So I think that experience will be reflected.

Of the other countries, Jordan is a very small country, and their hope, I believe, is to finance a lot of their oil shale development with funding from international banks, such as the World Bank and big commercial banks. Those banks are constrained in their lending practices by the Equator principles, which is a set of envi-

ronmental and social standards which the banks agree to maintain in any project that they support with their financing. And if the projects do not meet those requirements, then the loans will not be made.

So Jordan in particular is under the gun to make sure that the industry is developed in a responsible manner in compliance with world standards for environmental and social protection.

Now the specifics of what they are doing, what types of equipment they are adding to their plants to ensure that that compliance occurs, I don't know. One suggestion I have for the Government is that they try and find out by engaging in those projects by sharing experience and expertise with countries like Jordan that would be very glad to get it.

Mr. LAMBORN. All right. Thank you.

Professor Spinti, what is the difference between the use of water for a surface mining basic approach, like the retort method, versus the in-situ processes that companies in Colorado are researching, from a chemical engineering standpoint?

Ms. SPINTI. Yes. So, actually, most of the development in Utah, which I am most familiar with, is surface mining. And so, it is ex situ. Because of the resources that are available, non-Federal resources, the resource is actually more amenable to mining. And so, and most of those companies are not using that much water, per se, in the process itself.

So they have some sort of retort, but they require water for ancillary uses and for dust control for—so they have the spent shale when they are done, and so they use water—well, nobody has got commercial production. But you would use water to cool off the shale and for dust control. It turns out that those can be fairly large uses, the dust control.

For in-situ production processes, one of the concerns there is what is left over once you are done. So, what is in the ground, and does it have a potential to contaminate groundwater? So how much flushing do you have to do once you are done producing?

And then also the other issue in Colorado is just that some of the rich oil shale zones are in the aquifer, and so you have to worry about issues of water contamination of the aquifer with in-situ production if you are in that particular zone. In Utah, some of the richest zones actually don't have that problem because they are below the level of one of the main aquifers.

Mr. LAMBORN. All right. Thank you all.

Representative Tipton?

Mr. TIPTON. Thank you, Congressman Lamborn.

And Mr. Sladek, I may not have caught—you mentioned rare earths in part of your testimony. Have there been some studies, when you were talking about Estonia, Jordan, Egypt, Syria, of extraction of some of the rare earths?

Dr. SLADEK. I am not aware of any specifically aimed toward rare earths. Jordan has spent a great deal of time looking for uranium in their oil shale region, and they have found some. In fact, that introduced a substantial delay in their oil shale program because the leasing program was suspended while they attempted to find out if the uranium was of commercial interest.

The rare earths are a relatively new topic in world commerce, but an increasingly important one. I know that there have been very detailed studies done of the geochemistry of the Green River formation oil shales, and I know that data have been published on concentrations of rare earths in specific samples that were analyzed. That has been a long, long time ago, and I doubt that the data are current and probably not terribly reliable. But it is a useful thing to look at.

You mentioned aluminum in your question to Mr. Johnson. There is a lot of aluminum in oil shale, and some of it is potentially recoverable.

Mr. TIPTON. Since you have a little bit of background on this because it is the entire package, is lithium pretty prevalent, depending on some of the formations?

Dr. SLADEK. Not to my knowledge, I am afraid. I do not know.

Mr. TIPTON. OK. All right. Important issue, I think, obviously, because, as Ms. Spinti was noting, some of the production techniques over in China are not the best.

Dr. SLADEK. Yes, I agree.

Mr. TIPTON. And on the reliability end of that.

Mr. Hagood, could you maybe give us a little bit of background in terms of maybe just an estimate? Obviously, listening to a lot of the testimony, there is a lot to take into consideration that when we are looking back on even an employment issue, if we were able to get this industry moving, were able to have that cost effective, what are some of the job estimates in regard to this?

Mr. HAGOOD. Yes, I am not familiar with the job estimates, but I can point to maybe an analog, and that is with the oil sands industry up in Alberta. And if you consider that it has taken them several decades to get to a production of 1.5 million barrels per day, but that has resulted in a tremendous amount of employment in the area of Calgary and Edmonton and Fort McMurray, and also the side benefits associated with that, which has led to creation of world-class universities and research institutes, which, in turn, employ a number of individuals.

But I can't give you an actual estimate on that.

Mr. TIPTON. It is probably unfair to even ask you, but do you know what the unemployment rate is up there?

Mr. HAGOOD. No, I don't. It is very low, and——

Mr. TIPTON. It is low?

Mr. HAGOOD.—the cost of housing, by the way, which is another socioeconomic impact, but it is pretty high.

Mr. TIPTON. Right.

Mr. HAGOOD. In fact, Calgary, and this is just in general, associated with the entire oil and gas industry, is the largest U.S. ex-pat community in the world. And they actually do recruit quite heavily down the United States to attract welders and other folks to work up in Fort McMurray.

But it is quite a healthy environment for employment.

Mr. TIPTON. Great. Thank you.

And Ms. Mittal, you had mentioned something that I think is very important as well. We seem to have a lot of entities within Government that fail to speak to each other or to be able to share

some of that information. And you were talking about DOE and Interior not currently sharing some of that information.

You made a recommendation. Are you aware of any moves to actually make that happen?

Ms. MITTAL. We did recommend that Interior and DOE, as well as the State regulatory officials, because they are a really important part of this process, be involved and they develop some sort of a formal mechanism to share information about research that they have currently ongoing.

Right now, what we have found is they do not have a formal mechanism. So they have to rely on informal mechanisms, and those don't always get the job done.

Mr. TIPTON. And that creates uncertainty?

Ms. MITTAL. Yes.

Mr. TIPTON. Yes, I am sure it does. I just wanted to get it clarified because I made the same note that Congressman Lamborn did in that we have in terms of large volume, a pretty significant discrepancy between your estimate in terms of water usage versus Ms. Spinti's estimate of water usage.

Ms. MITTAL. I think the big difference between our estimate and some of the studies that are out there is we looked at the whole life cycle of oil shale production. There are some studies that only look at the direct impacts. So that is the actual production of the oil versus we looked at the whole life cycle.

So you are starting with—we took every single activity that is involved in the oil shale life cycle production, direct activities as well as indirect activities. We grouped them into five groups, and then we looked at the most optimistic water use scenarios and the most pessimistic water use scenarios, and we added all of those up.

Because what we wanted to do was provide a comprehensive, consistent, and complete package of information. Obviously, when we talked to industry and water experts, they told us that the extremes in our ranges probably will not get met. So, it will be somewhere in the middle.

So that is why the three to five range that I mentioned in my statement, that is probably going to be where we end up.

Mr. TIPTON. And it would probably be hard to measure, but it sounds, from what you are describing to me, at least, that it is kind of a static model as opposed to a dynamic model that you were really looking at?

Ms. MITTAL. Right.

Mr. TIPTON. Not anticipating with current technology, without development processes, that maybe it will actually reduce water consumption. Is that accurate?

Ms. MITTAL. Absolutely. Absolutely. That was one thing that was very clear when we talked to the industry. Reducing water use is very high on their radar screen. They are looking for ways to reduce that. The more they can come up with new technologies that limit that use, the more we will go toward that lower range.

But the bottom line is there is a lot of uncertainty right now, as Ms. Spinti said, about the reclamation and the in-situ process. We don't know how many times we are going to have to rinse the retort zone. It could be two or three times like some researchers expect. That is about a barrel of water. If we have to do 20 rinses,

that could be over 5 barrels of water, and that is the uncertainty that is part of the equation right now.

Mr. TIPTON. Great. Thank you.

Mr. LAMBORN. All right. Thank you.

Mr. Hagood, in preparing for this hearing, we invited the Department of Energy to also come and testify, but they did not want to do so because they have no current oil shale programs. So they didn't feel they had a lot to offer.

Do you believe that basic research and investment in domestic oil shale development would be a good thing for the Department of Energy to be doing? And larger than that, will this help—and I think I know what you are going to say. But will that help us reduce our dependence on foreign sources of energy?

Mr. HAGOOD. Relative to your first comment, indeed, basic research is very important to this topic. And given, as I mentioned before, the size of the resource I think is essential and a tremendously good investment.

But also add that it needs to be more than just basic research. It needs to be applied and moving toward demonstration and, as mentioned earlier, toward reducing the risks associated with deployment.

Second question again?

Mr. LAMBORN. How would this help reduce our dependence on foreign energy?

Mr. HAGOOD. So, currently, we import between 50 to 60 percent of our oil primarily directed toward transportation. The current use today in the United States is roughly between 18 million and 19 million barrels per day. Five million of that is produced domestically.

Therefore, if you look at the top providers of our oil from import, they basically consist of Canada, Nigeria, Saudi Arabia, Venezuela, and I forgot the last one.

Voice. Mexico.

Mr. HAGOOD. Thank you very much. Mexico.

[Laughter.]

Mr. HAGOOD. And which, by the way, has a declining reserve. So if you look at all of that, and 2.5 million barrels come from Canada—most of that actually from the oil sands, increasingly so—it would be very important for the United States to reduce its vulnerability on accepting imports from those other sources. So it is really a risk management aspect to me toward developing our own resources and managing that risk more smartly over the long term.

Mr. LAMBORN. As a follow-up, is the particular products that are produced by certain techniques, the blend of petrochemical, the resulting blend, is that of significance? Like if it is more weighted toward what would normally take more refining because some of the refining, in effect, is already done in the process?

Mr. HAGOOD. I am not sure I am capturing the question, Chairman.

Mr. LAMBORN. Like if you get more jet fuel, for instance, than you would if from a heavy like tar sand?

Mr. HAGOOD. Yes, I can't speak to that, Chairman.

Mr. LAMBORN. OK.

Mr. HAGOOD. But indeed, I think in general you can take a number of these types of resources, whether it is oil sands or tar sands or oil shale, and convert them into a number of different types of products. Currently, the U.S. does have significant refining capacity to take a lot of that import or domestic resource to refine to a number of different products.

Mr. LAMBORN. OK. And then my last question for you or anyone on the panel is what can Congress be doing in a responsible way to make sure that we are continuing to look at this potentially valuable resource and not drop the ball?

I am going to start with you, Mr. Hagood.

Mr. HAGOOD. Well, I think my recommendation is, and again, it goes back to this is a world-class resource. It is going to be long-lived. It will be with us through this entire century, and it is important for us to steward that in an environmentally responsible way, but to use it and develop it for our energy security, but also for our economy.

So I do believe that this deserves—at least from the research perspective, deserves a more focused and integrated approach to address the challenges associated with development of these resources. It is being done, albeit with oil sands, in Alberta, but it is a proactive, can-do attitude to develop those resources. And if they find a problem, they put their money where their mouth is to address the problem through both Government and industry.

I think that same type of attitude may be exercised through a program focused in western oil shale is needed.

Mr. LAMBORN. OK. Thank you.

Anyone else on the panel? Doctor?

Dr. SLADEK. Yes, I would like to second that, and also this outreach program that I alluded to earlier to put the Department of Energy back in the oil shale business and specifically to track what is going on in other countries and to join in those projects.

Not just because it is nice to help other people, but because you can bring information back to this country that will be very helpful in the emergence of our industry. Water conservation, for example, is even more of an issue in Jordan than it is in the Western United States. They have no water. And what they do have in the ground is committed not only to their own people, but the surrounding countries.

They must reduce water consumption in oil shale production. They could use some help in doing that, and the help that is provided could come back to help us.

I would also like to supplement Dr. Hagood's response about whether shale oil is a better source of jet fuel and diesel fuel than it is of other petrochemicals. The Green River formation of crude oil shale is a better source of the middle distillates, jet fuel and diesel fuel specifically, than it is of gasoline. So, in terms of providing our motor fleet and our trains, it is a good source of energy for doing that.

Mr. LAMBORN. OK. Thank you.

Either one of you?

Ms. SPINTI. I always have something to say.

Mr. LAMBORN. Good.

Ms. SPINTI. OK. So just to comment, there was actually a really good policy paper that came out that I can send to your assistants that talks about some of these policy issues and how they affect the markets.

Mr. LAMBORN. Please do.

Ms. SPINTI. And one of those issues is that we were just—I was actually traveling in Scandinavia this summer, driving a nine-passenger diesel van and gasoline there is very expensive, or diesel. We were dreading every time we had to go fill up. But we were getting like 45 to 50 miles per gallon.

And you get a much higher efficiency with a diesel engine, but the problem is the way certain laws have been written in the U.S. favor gasoline. Anyway, that paper has a very good explanation of that.

So it depends on what you want to drive demand for. But if you want to drive demand for diesel fuel, then you need to look at the laws that are driving demand for gasoline because there are certainly technical advantages to having a diesel engine.

OK. So there are two other comments I wanted to make. Our funding comes through DOE, the National Energy Technology Laboratory so I guess I am a little surprised at their response. Maybe they are not aware of us?

We have been working for about the last 5 years, and we are the only funded program in the U.S. So, the problem in academia is, of course, as a professor, a research professor especially, you are only working on what you are funded for. Now that we are at the end of 5 years and we are nearing the end of our funding, we have assembled what we feel a very strong group of researchers in law, economics, science, and engineering.

And the problem is if there is no more money, all those people go off and work on other problems. So if you want smart people working on problems, then there has to be a funding source so that you are not jumping from one thing to another every 4- or 5-year cycle.

Then, finally, I come from the simulation group, computational fluid dynamics, and we feel strongly that the future is simulation, and that if we want to have these simulation tools that will give us quantified predictivity. So what is our uncertainty, and how well do we know that uncertainty? So that we can say not just, well, this might happen if you build this. But we can say, you know what, we have done these simulations, and we can tell you that this is the uncertainty of what will happen, and here is your answer.

To be able to do that, we need to have data. That means we have to be able to have companies and national laboratories and other people doing research willing to share their data so that we can do this validation.

Thank you.

Mr. LAMBORN. And briefly, Ms. Mittal?

Ms. MITTAL. Just very briefly, I would ask that Congress hold Interior accountable for collecting the baseline water data that we need. Because if we don't have that baseline information now before the industry starts, we will not be able to attribute any changes in water resources back to the oil shale industry.

So it really impacts their ability to monitor and mitigate future impacts. So hold them accountable for gathering that data.

Mr. LAMBORN. OK. Thank each one of you.

Representative Tipton?

Mr. TIPTON. Thank you. I am good.

Mr. LAMBORN. OK. I would like to ask all the witnesses to please respond in writing if any of the members of the Committee submit questions to you.

Mr. LAMBORN. Thank you for being here, and we appreciate it.

I will now call the last panel up, and that consists of Mr. Dan Whitney, the Upstream Americas Heavy Oil Development Manager for Shell Exploration and Production Company; Mr. Gary Aho, Board Member and former Chairman of the National Oil Shale Association; Mr. Brad McCloud, Executive Director of Environmentally Conscious Consumers for Oil Shale; and Mr. Jim Spehar, probably no stranger here, former Mayor of Grand Junction and former Mesa County Commissioner.

Thank you all for being here.

As I mentioned earlier with the two previous panels, your written testimony will appear in full in the hearing record. So I ask that you keep your oral statements to 5 minutes, as outlined in our invitation letter to you.

The microphones are automatic. You don't have to press any buttons. The timing lights will turn yellow after 4 minutes and red after 5 minutes.

We will now begin with our first witness, and that would be Mr. Whitney.

STATEMENT OF DAN WHITNEY, UPSTREAM AMERICAS HEAVY OIL DEVELOPMENT MANAGER, SHELL EXPLORATION AND PRODUCTION COMPANY

Mr. WHITNEY. Chairman Lamborn, Representative Tipton, thank you for having me here today.

I am pleased to have the opportunity to speak with you about oil shale development. Today, I would like to focus on three points. First is the growing world energy demand and our Nation's need for secure supplies, Shell's commitment to a cautious approach on oil shale, and finally, the importance of future regulatory stability in assuring new energy development.

Global energy demand is high and rising constantly. So is competition for energy resources and the investment needed to develop them. Growing populations and economies in China, India, and elsewhere will at least double demand by 2050.

Today, about 80 percent of the world's energy comes from coal, oil, and natural gas. At most, nuclear and renewable sources might meet a third of the world's needs by mid century. Fossil fuels will supply the rest. While the mixed percentage will be a little bit lower, demand growth means that the world will actually be burning more fossil fuel at mid century than it does today.

Most of that increase will have to come from sources undeveloped and even undiscovered today and often in remote and challenging locations, such as the Arctic and ultra deep water, but not always. As you know, there are vast unconventional oil resources here in Colorado in the form of oil shale, some of the world's richest hydro-

carbon deposits. Properly developed, they could play a major role in U.S. energy security.

The U.S. Geological Survey and others estimate recoverable U.S. oil shale reserves at more than 800 billion barrels, enough to supply the U.S. for more than a century. Shell is committed to a cautious approach in our oil shale efforts. Since the early 1980s, Shell has pursued steady research and development of the in-situ conversion process as a means to produce from oil shale in an environmentally responsible and socially sustainable manner.

This has required dedicated scientific application and a significant financial investment, many tens of millions of dollars. Oil shale's long research cycle time and high upfront capital costs need consistent Government policy and regulatory certainty. Gaining experience and building industry capacity must occur before new technology can contribute meaningfully to energy supply. This requires billions of dollars and patient investment spread over decades.

Predictable rules, created in a thorough, well understood, and legally established process, are critical to that type of long-term commitment. Unfortunately, weakening regulatory certainty is the trend and a negative for U.S. energy development.

A case in point is the BLM's reopening of the 2008 PEIS covering oil shale in the Piceance Basin. The existing, fully vetted, comprehensive 1,800-page PEIS is less than 3 years old. No material new information has emerged to merit this revisit in so short a time. The entire exercise ignores the comprehensive framework of regulatory checks and balances already in place, including site-specific NEPA reviews that will apply to every future oil shale project under Federal jurisdiction.

Since the stated concerns are already covered, this PEIS fresh look is a waste of taxpayer money and a deterrent to industry confidence and future capital investment. Shell firmly believes that if foreign technology and those being tested by other energy companies can be proven through the RD&D program, we can unlock a significant long-term domestic energy source for the U.S. To do this, industry needs a regulatory regime that fosters innovation and encourages production growth.

An environmentally driven, no development policy in the Piceance is unwise. Social and economic benefits, national energy needs, and other realities must be considered.

Our country is in resource competition with the world. We need energy in every form, and we are sitting on the world's largest and most concentrated energy resource. It can be developed responsibly, and it will be needed maybe sooner rather than later.

Thank you for listening to my testimony.

[The prepared statement of Mr. Whitney follows:]

Statement of Dan Whitney, Heavy Oil Development Manager, Shell Exploration and Production Company

Chairman Lamborn, members of the Subcommittee on Energy and Minerals. I am pleased to have this opportunity to speak with you today on the topic of oil shale development.

I will focus on three points:

1. Growing world energy demand and our nation's need for secure supplies,
2. Shell's commitment to a cautious approach on oil shale, and

3. The importance of future regulatory stability in assuring new energy development.

Global energy demand is high and increasing constantly. So is international competition for limited energy resources and the investments needed to develop them.

Growing populations and economies in China, India, and elsewhere will at least double energy demand by 2050. Some analysts say it could triple.

One thing certain is we will need a lot more energy. The world will depend on fossil fuels for decades until technology and economics can deliver a larger contribution by alternative energy sources.

Today about 80% of the world's energy comes from coal, oil and natural gas. At most, nuclear and renewable energy sources might meet a third of the world's needs by mid-century—fossil fuels will supply the rest. And, while the percentage will be a little lower, demand growth means the world will actually be burning more fossil fuel at mid-century than it does today

Most of that increase will have to come from sources undeveloped and even undiscovered today. We will need every available energy source—renewable, alternative and conventional—and greater efficiency too.

As you know, there are vast unconventional oil resources here in Colorado, in the form of oil shale—some of the world's richest hydrocarbon deposits. Properly developed, they could be a major component of US energy security.

The U.S. Geological Survey (USGS) estimates recoverable reserves at more than 800 billion barrels, enough to supply the US for more than a century at current consumption rates.

The challenge of developing a commercial oil shale industry starts with its geologic state. The Green River Formation is a carbonate rock, generally marlstone that is very rich in kerogen. This source of oil has not had the natural forces of pressure and temperature over the millennia to convert it to oil and gas. So, unlike conventional oil and gas operations, oil shale cannot be pumped directly from the ground. Oil Shale must be processed either above ground or in place (in situ) to convert the kerogen into oil.

Shell is committed to a cautious approach in oil shale research and development. Shell has pursued the technical and commercial development of the In situ Conversion Process (ICP) for oil shale since the early 1980s as a means to produce from oil shale—in an environmentally responsible and socially sustainable manner. This has required considerable dedicated scientific application and significant financial investment—many tens of millions of dollars.

To date, through persistence and much effort, a logical progression of work has been completed from desk top studies, to laboratory scale testing, to prototype scale testing, and finally to field pilot testing in Colorado.

Shell's seven previous Colorado pilot projects have tested broad technology themes, including:

(1) Demonstrating that the technology works,
(2) Measuring energy balance and recovery efficiency necessary to estimate commercial project economics,
(3) Producing and measuring the properties of ICP oil and gas,
(4) Proving that the groundwater can be protected, and
(5) Testing the effectiveness of a variety of heat delivery methods.

In the process, Shell has carried out extensive pre-operational environmental assessments. Shell has given careful attention to archaeologically sensitive areas by completely assessing and avoiding such areas, and has cooperated fully with agencies such as the State Historical Preservation Office and BLM to identify and avoid areas of critical environmental concern, including establishing conservation easements to provide permanent protection of certain areas.

Shell also funds research into environmental restoration and recently established a professorial chair in the subject at Colorado State University. Shell has also demonstrated, through its own research and field trials, that disturbed lands can be returned to beneficial uses that are equivalent to the pre-disturbance conditions, and was recognized by the BLM for these efforts.

The long cycle time of research and high up-front capital requirements of an oil shale project, need broad and consistent government support to establish a commercial industry. Supporting government policy and regulatory certainty are necessary for private industry to reasonably assess risks and economics, and be confident in that assessment, so that the billions of dollars in required investment can be made.

Commercial scale technologies with economically attractive recovery efficiency and acceptable environmental impacts are prerequisite for success. The road to commercialization is likely to be measured in decades not years—a long time horizon is necessary to allow development to occur through the "bust and boom" oil and gas price cycles.

This extended time frame for supply growth and commercial viability is not unique to unconventional oil. Looking back through history, it consistently takes around 30 years for new forms of energy to achieve 1 percent market share after a commercial business is established. Biofuels are just now reaching 1 percent of the world oil market, or about 0.5 percent of total energy, after decades of development and government support. Wind may get to the 1 percent mark in the next few years, nearly three decades after the first large wind farms were built in Denmark and here in the United States.

Gaining experience and building industry capacity must occur before a new technology can contribute meaningfully to energy supply—and this requires billions of dollars in patient investment over decades in the hope of eventual growth. Regulatory stability is critical. This kind of commitment depends on predictable rules created in a well understood, legally established and exhaustive process.

Weakening regulatory certainty is a negative trend for US energy development.

A key case in point is the BLM's re-opening of the 2008 PEIS covering Piceance Basin oil shale on the basis of "concerns" already fully covered by existing regulatory programs.

Potential ramifications of re-writing the existing regulations include:

- lower capital investment,
- lower domestic oil production,
- higher oil imports—(costing hundreds billions that might otherwise be invested within the US,)
- higher unemployment (a natural consequence of reduced investment,)
- lower tax revenues from royalties, federal and state corporate and individual incomes taxes, severance tax, and property and sales taxes, and
- lower overall economic growth.

The existing, fully vetted, comprehensive, 1800 page PEIS is less than three years old. No substantive new information has emerged that merits this revisit in such a short time.

The entire exercise ignores the comprehensive framework of regulatory checks and balances already in place in the form of environmental (and other) laws, including site specific NEPA review, that will apply to every future oil shale project under federal jurisdiction.

Remarkably, all five areas proposed for removal from development as identified in the Notice (i.e. those with wilderness characteristics, "very rare or uncommon" designation, sage grouse habitat, "areas of critical environmental concern", and areas made off limits in the original PEIS) are already either

(a) precluded from development by Federal or State statutes,
(b) precluded from development under the original PEIS, or
(c) may be precluded under the existing leasing authority assigned to BLM land managers.

Given that there are already adequate checks and balances provided in existing regulatory programs to accomplish the stated basis for this PEIS, Shell views the "fresh look" at the PEIS as an inefficient and unnecessary use of taxpayer money and as a significant deterrent to capital investment by Shell and others in the energy industry.

While questions and challenges remain regarding the future implementation of oil shale technology, Shell believes that commitment by the Federal Government to maintaining a regulatory environment that encourages investment in oil shale RD&D, as defined in the 2005 Energy Act and the subsequent regulations including the 2008 PEIS, is critical to long term success.

The lack of policy and regulatory consistency from one administration to another makes the investment climate even more risky and potentially untenable.

For Shell to make informed investment decisions, we must be able to predict the likely costs of future development. This includes royalties, bonds, reclamation requirements, lease duration, diligent development requirements, commercial leas conversion process and other aspects of permitting, lease administration, and commercial operation.

Given the substantial investments necessary for oil shale pilots, research and commercial facilities, regulatory uncertainty has significant adverse impact on Shell's interests. To put it another way, the 2008 Oil Shale Rules and associated regulatory processes provide certainty and basis for investment decision. Reopening elements, of which the PEIS is one, and the prospect of future changes removes that certainty.

Shell firmly believes that if our technology and those being tested by other energy companies can be proven through RD&D testing, we can unlock a significant long term domestic energy source for the US. To do this, industry needs a regulatory environment that fosters innovation and results in production growth. This is accom-

plished by providing access to acreage with sufficient oil shale resources combined with long-term stable fiscal regimes and regulatory processes that provide industry the certainty and time needed to develop oil shale.

Our country is in competition with the world for energy resources. We need energy in every form, and we are sitting on the largest and most concentrated energy resource on the planet. And it will be needed, potentially sooner rather than later.

The benefits are huge. Consider this: an acre disturbed for corn production might generate the energy equivalent of 10 barrels of oil per year, and an acre of conventional oil and gas production might generate the equivalent of 10,000 barrels of oil, but an acre of oil shale in the Piceance Basin of Colorado has the potential to produce well over 1,000,000 barrels of oil. So the energy produced per acre disturbed is well over 100 times greater than any other known form of energy development. Colorado's oil shale is literally the richest and most concentrated hydrocarbon energy resource on the planet.

Shell has often said, we intend to develop oil shale in a manner that is economically viable, environmentally responsible and socially sustainable. If one only focuses on environmental concerns without also considering the socioeconomics, national energy needs, and the facts and realities of the situation, it becomes clear that a "no development" policy is unsustainable. As NEPA requires, the environmental and social impacts and benefits of any proposed action need to be considered. Our country needs energy in every form. There is clearly a path forward where our energy needs are supplemented with oil shale, while managing and mitigating impacts of development.

Thank you for considering my testimony.

Mr. LAMBORN. All right. Thank you.

Mr. Aho?

STATEMENT OF GARY AHO, BOARD MEMBER/FORMER CHAIRMAN, NATIONAL OIL SHALE ASSOCIATION

Mr. AHO. Thank you, Mr. Chairman and Mr. Tipton, for the opportunity to speak here today.

My name is Gary Aho. I am here today representing the National Oil Shale Association. I am an industry representative. I have over 35 years of experience with oil shale, starting out as a chief engineering, becoming a manager, vice president, and eventually the president of two of the oil shale companies that have been active in the Western States.

The National Oil Shale Association is a not-for-profit organization with the goal of educating the public and providing factual information on oil shale. Our members consist of corporations, university and research groups, national laboratories, and individuals. We print written materials that are carefully scrutinized to assure that all statements are accurate and supported by factual data and sound references. We are not a lobbying organization.

Today, I would like to enter for the record our most recent 2010 publication, entitled "Oil Shale: America's Untapped Energy Source." The purpose for this newest publication is to present facts about oil shale, lay out the benefits to the Nation and to this region, present challenges facing the development of oil shale, and discuss a way to arrest many of the misconceptions that persistently surround oil shale.

This NOSA publication was carefully prepared and edited by experienced oil shale veterans, each with many years of experience in trying to get an oil shale industry started in the United States. Today, there are just a few key points for the time I have allotted that I would like to make from this particular publication.

First of all, as we have heard, the U.S. has nearly 70 percent of the world's oil shale resources, and the deposits in the Western United States contain more oil than the world's proven reserves of conventional oil. At a time like this, when our Nation is going through tremendous economic uncertainty, developing oil shale in the Western United States would create tens of thousands of high-paying jobs, reduce the Nation's dependency on foreign oil, improve the balance of trade, enhance national security, provide stimulus to the economy, and generate tax revenues for all levels of Government.

There are already a number of proven and unproven technologies to produce shale oil, and production is occurring, as we have heard here today, in the countries of Estonia, Brazil, and China. We believe that shale oil can be produced in the United States safely and in an environmentally responsible manner. Industry and research organizations will figure out the best technologies if the incentives to do so exist and if the roadblocks are minimized.

The Federal Government through the BLM controls only 70 percent of the Western oil shale resources and some of the best resources. However, there is currently no Federal oil shale leasing program. Despite the fact that oil shale was placed under the Mineral Leasing Act of 1920 and was to be made available for public leasing, here it is 90 years later and, shame on us, we still don't have a leasing program in this country.

As a nation, we have made a number of efforts to develop oil shale, and there have been many successful research programs completed over the past 90 years. However, we seem to lack the national resolve to keep a sustained oil shale program moving forward, and we have heard that again today with the lack of budgets, and these programs within the DOE, for example, start and stop.

The most recent unconventional fuels legislation was the Energy Security Act of 2005 that laid out a program and mandated certain research and leasing activities. While that program got off to a great start, it, too, appears to be floundering, despite the fact that the actions required therein are very explicit.

NOSA believes that the BLM should make lands available for lease. These lands should have terms, including rents and royalties, which are favorable for this capital-intensive, high-risk, unconventional fuels industry. Sufficient regulations and environmental rules and regulations already exist on the books. Industry should be allowed to select the technologies since it is industry that takes the investment risks.

It should be up to industry to conduct the research and develop the best technologies, realizing that the technologies will evolve with time and experience. Just because the BLM leases oil shale property to a corporation, there is no assurance that the project will develop. Industry must still design the project, secure its permits, comply with NEPA, secure water and other services, get the buy-in of the stakeholders, arrange financing, and so forth.

The burden falls on industry. BLM must simply make leases available. If it is in the Nation's best interest to develop oil shale, and we believe it is, then the Government should make the land

available, expedite the permitting process in cooperation with State and local agencies, and then let industry make it happen.

Industry needs a clear, consistent Federal program and a national commitment to develop oil shale. Access to lands and regulatory certainty are crucial to corporations starting a new capital-intensive industry such as oil shale.

I thank you for the opportunity to appear here today. The National Oil Shale Association feels this hearing is very timely, and we thank you for your vision and your willingness to address the impeding development of oil shale, America's untapped energy source.

Thank you.

[The prepared statement of Mr. Aho follows:]

Statement of Gary D. Aho on behalf of the National Oil Shale Association

Mr. Chairman and Members of the Subcommittee, my name is Gary D. Aho and I am here today representing the National Oil Shale Association, a not-for-profit organization with the goal of educating the public and providing factual information on oil shale. Our members consist of corporations, university research groups, national laboratories and individuals. We print written materials that are carefully scrutinized to assure that all statements are accurate and supported by factual data and sound references. We are not a lobbying organization.

Today I would like to enter for the record our most recent 2010 publication entitled "Oil Shale, America's Untapped Energy Source". This publication is intended to (1) present facts about oil shale, (2) layout benefits to the nation and the region, (3) present the challenges facing the development of oil shale, and (4) discuss and lay to rest the misconceptions that persistently surround oil shale. This NOSA publication was carefully prepared and edited by experienced oil shale veterans, each with years of experience in trying to get an oil industry started in the United States.

There are a few key points that I would like to focus on today:

- The US has the nearly 70% of the world's oil shale resources and the deposits in the western US contain more oil than the world's proven oil supplies.
- Developing oil shale in the western US would create tens of thousands of high paying jobs, reduce the nation's dependency on foreign oil, improve the balance of trade, enhance national security, provide a stimulus to the economy, and generate tax revenues for all levels of government.
- There are already a number of proven and unproven technologies to produce shale oil and production is occurring now in other nations, such as Estonia, Brazil and China.
- We believe that shale oil can be produced in the US, safely and in an environmental responsible manner. Industry and research organizations will figure out the best technologies, if the incentives exist to do so and if the roadblocks can be reduced.
- However, the federal government, through the BLM, controls nearly 80% of the oil shale lands and there is currently no oil shale leasing program, despite the fact that leasing was provided for under the Mineral Leasing Act of 1920. As a nation, we have made a number of efforts to develop oil shale and there have been many successful research programs completed over the past 90 years. However, we seem to lack the national resolve to keep a sustained oil shale program moving forward. The most recent unconventional fuels legislation was the Energy Security Act of 2005 that laid out a program and mandated certain research and leasing activities. While that program got off to a great start, it too appears to be floundering, despite the fact that the actions required therein are very explicit.
- NOSA believes that the BLM should make lands available for lease. Sufficient regulations and environmental laws already exist. Industry should be allowed to select the best technologies, realizing that industry takes the investment risks. It should be up to industry to conduct the research and develop the best technologies, realizing that the technologies will evolve with time and experience.
- Just because the BLM leases an oil shale property, there is no assurance that the project will develop. Industry must still design the project, secure permits,

comply with NEPA, secure water and other services, arrange financing, etc. The burden falls on industry. BLM must simply make the land available.

- If it is the nation's interest to develop oil shale, and we believe it is, then the government should make the land available, expedite the permitting process, and then let industry make it happen, while working with the numerous stakeholders in the local region.
- Industry needs a clear, consistent federal program and a national commitment to develop oil shale. Access to lands and regulatory certainty are crucial to companies starting a new, capital intensive industry.

Thank you for the opportunity to appear here today. NOSA feels this hearing is very timely and we thank you for your vision and your willingness to address the issues impeding the development of "Oil Shale, America's Untapped Energy Source".

National Oil Shale Association
P.O. Box 3080
Glenwood Springs, CO 81602
Phone 970–389–0879
Website: www.oilshaleassoc.org

Mr. LAMBORN. OK. Thank you, Mr. Aho.

Mr. McCloud?

STATEMENT OF BRAD McCLOUD, EXECUTIVE DIRECTOR, ENVIRONMENTALLY CONSCIOUS CONSUMERS FOR OIL SHALE

Mr. MCCLOUD. Good morning. As stated, my name is Brad McCloud. I am the Executive Director for ECCOS, or otherwise known as Environmentally Conscious Consumers for Oil Shale.

First, on behalf of myself and ECCOS, thank you to both Representatives Tipton and Lamborn for conducting these hearings and keeping the lines of communication open on an issue that we feel will impact the future security and economic prosperity for the United States.

The ECCOS is a grassroots, nonprofit group. We have members in Colorado and Utah, and we have plans to expand into Wyoming. We are one voice for consumers—consumers of groceries, consumers of cars, consumers of fishing and hunting and camping equipment, and consumers of homes. We are taxpayers, and we are voters.

We are not technical experts on oil shale. You have a roomful of many representatives today from the industry who can discuss in depth the ongoing development and research projects that are going on. Our mission is to educate the public and elected officials about oil shale energy and issues to promote the development of oil shale in order to decrease our Nation's dependency on foreign fossil fuels. We also feel that a strong energy policy—clear, consistent, and environmentally responsible—is necessary for both energy security and to maintain and grow good-paying jobs here in the United States.

The development of oil shale and other domestic energy fuel sources will lead to energy independence for the United States, but the current policy of regulatory uncertainty in the United States will systematically dismantle the progress being made by the oil shale industry in recent years and further delay or halt the projects in the future.

The Energy Policy Act of 2005 that has been referred to often today was a clear policy with clear direction and indicated the importance of oil shale development. The process was comprehensive. It was open, and it was rigorous. It achieved the resource develop-

ment goals of the Energy Policy Act of 2005 and, along with follow-up amendments in 2008, protected the environment and recreational uses of those public lands.

However, in December of 2007, then-Senator Ken Salazar inserted a moratorium on enacting rules for oil shale development on Federal lands in an omnibus spending bill. Come forward to 2011, not quite 3 years after the initial PEIS was finished in 2008, under a new administration and now Secretary of the Interior Ken Salazar, the BLM issued another notice to prepare a new PEIS. The only thing that changed roughly in about that 3 years is that technology in the oil shale industry had improved.

Initiating a new PEIS on the same topic was not only a redundant waste of time and resources, but it caused concern and instability for an industry by once again arbitrarily changing the rules of the game.

Currently, the unemployment rate in Grand Junction is around 10.5 percent. Up valley, you can go to Garfield County, it is about 10.7 percent. Colorado overall is about 9.2 percent. And if we go just east—we will go to Utah—it is about 7.5 percent. Nationally, I probably don't have to tell you that we are shockingly high. It is still around 9.1 percent for unemployment.

Recently, very recently, actually, an independent business information service called Visiongain released a report—and I can give you more information on it if you like. But the report calculates what it calls the global oil shale market. It does this by estimating spending on upgrading existing oil shale facilities, new infrastructure, and spending on R&D.

The report calculates that the value on that global oil shale market to be worth just over $2.8 billion alone in 2011. Now it seems that it would make—it seems that finding a way to capitalize on just a portion of those billions of dollars in the Visiongain report that they mention could go a long ways into lowering unemployment rates, improving our roads and our schools and our national and local economies.

If the United States wants companies to invest in oil shale research and development, as it claims, then companies must be provided a path to commercialization. The U.S. is sitting on a massive oil reserve. We are a stable nation with excellent safety and environmentally protective laws.

The world would be well served by having a stable supply of oil from the United States, and our local and national economies would benefit immensely. America can be the world's leader in oil shale, but industry will not continue to invest in environmentally responsible technologies without consistent regulation and stable oversight from the Federal Government.

ECCOS feels it necessary to point out inconsistencies in the policies of the Federal Government between administrations and the very political nature of these exercises that over the years have discouraged the development of oil shale production and potential energy independence for the United States.

To help stabilize gasoline prices, create good-paying jobs, and make the U.S. less reliant on foreign governments for our energy needs, the U.S. must maintain an environment of regulatory consistency. Policy cannot be allowed to be arbitrarily changed every

3 to 4 years. If the U.S. can implement such a policy, we ensure a brighter future for our energy security, our national economy, and our local economies.

And once again, I respectfully thank you for your time today.

[The prepared statement of Mr. McCloud follows:]

Statement of Brad McCloud, Executive Director, Environmentally Conscious Consumers for Oil Shale (E.C.C.O.S.)

On behalf of Environmentally Conscious Consumers for Oil Shale (or ECCOS) we want to thank Representatives Tipton and Lamborn as well as the Subcommittee on Energy and Mineral Resources for conducting this oil shale hearing and keeping the lines of communication open on an issue that has potentially prodigious and lasting impacts on the future energy security and economic prosperity of the United States.

ECCOS is a grassroots, nonprofit group based in Grand Junction, Colorado. We have members in Colorado and Utah. Our mission is to educate the public and elected officials about oil shale and energy issues. We are not an advocacy group. However, we would like to see research into oil shale continue.

The title of today's hearing strikes directly at the issue of what is at stake with the current policies and attitudes coming from the current administration and the U.S. Department of the Interior. A strong energy policy is necessary for both energy security and to maintain and grow good paying jobs in the United States.

Many believe development of oil shale and other domestic energy fuel sources could very well lead to energy independence for the United States, but the current policy of regulatory uncertainty in the U.S. will systematically dismantle the progress made by the oil shale industry in recent years and further delay or halt projects in the future.

For a recent example of instability in policies affecting the industry one only needs to look at the Energy Policy Act of 2005. It provided a clear policy direction that indicated the paramount importance of oil shale development to contribute to a viable, realistic path to meet urgent national energy needs and carefully balance the economic realities of oil shale development with appropriate environmental and socioeconomic safeguards. It, in addition to the 2008 Oil Shale Rule and 2008 RMP *("Approved Resources Management Plan Amendments/Record of Decision for Oil Shale and Tar Sands Resources to Address Land Use Allocations in CO, UT and WY"*) Amendments established legal parameters for oil shale leasing in northwestern CO, southwestern WY, and northeastern UT. The administrative process was comprehensive, open, and rigorous. Most importantly, it achieved the resource development goals of the Energy Policy Act of 2005 and protected the environment and recreational uses of public lands.

A good example of this instability came in December of 2007 when then Senator Ken Salazar inserted a moratorium on enacting rules for oil shale development on federal lands into an omnibus spending bill, then pushed in May of 2008 to extend the moratorium for another year and then less than three years after the initial PEIS was completed in 2008 (April of 2011) the BLM, under a new administration and now Secretary of the Interior Ken Salazar, issued a "Notice of Intent to Prepare a Programmatic Environmental Impact Statement (PEIS)." Why? The redundancy of initiating a new PEIS on the same topic that was addressed three years ago is not only waste of time and resources, but it also causes concern and instability for an industry by once again arbitrarily changing the rules. If a project is forced to start and stop over and over, and is given no indication as to when clear policies will be provided and maintained, a company starts to wonder if it will ever see the light at the end of the tunnel. When issuing its notice of intent the BLM stated as its rationale ". . .there are not economically viable ways yet known to extract and process oil shale for commercial purposes..."

We feel that in many ways due to the redundancy of this process the BLM's rationale is a self-fulfilling prophecy. How can we expect companies to invest in oil shale research and development when the federal government creates uncertainty and stands in the way?

The only thing that has changed in the past three years is oil shale technologies have improved. There are several nations around the world that are aggressively pursuing oil shale development. We are in the midst of another energy crisis with gasoline prices approaching $4 per gallon. The unemployment rate in Grand Junction, Colorado and the United States is still staggeringly high, and there is even more unrest in the Middle East

The largest and richest reserves of recoverable oil shale (estimated at more than five times the amount of oil located in Saudi Arabia) are found in Colorado, Utah and Wyoming. If the United States wants companies to invest in oil shale research and development, as the current administration and those before it have claimed, then these companies must be provided a path to commercialization. Why would a company invest hundreds of millions of dollars into research, if they have no clear path to recouping that investment?

Companies like Shell, Chevron, American Shale Oil and Red Leaf Resources are continuing to develop exciting and new technologies that someday may lead to commercial viability and meet growing national and international energy needs. However, regulatory uncertainty has slowed research and development projects of oil shale dramatically and forced most investment dollars and the good paying jobs associated with those projects flowing in the direction of more development-friendly nations.

The fact is the U.S. will be reliant on oil for decades to come. Even with the aggressive deployment of hybrid, electric vehicle, natural gas, and biofuels technologies, the U.S. Energy Information Administration reported that by 2035 93% of vehicles in the U.S. will still run on oil and, world oil consumption will increase 30%. Our dependence on oil and non-renewable resources is going to remain an issue for generations.

The U.S. is sitting on a massive reserve of oil. We are a stable nation with excellent safety and environmental protection laws and a strong recognition of private property rights. The World would be well-served by having a stable supply of oil from the United States. And, our local and national economies stand to benefit immensely.

America can be a world leader in oil shale technology, but the private sector will not continue to invest in environmentally responsible oil shale technologies without consistent regulations and stable oversight from the federal government. This new PEIS process is just one example of how even more uncertainty is added into the equation for those companies trying to find an answer to our domestic energy needs.

In closing, I would like to reiterate ECCOS is not an advocacy group. However, we feel it necessary to point out inconsistencies in the policies of the federal government between administrations and the very political nature of these exercises that over the years has discouraged the development of oil shale production and the potential energy independence of the United States. If you truly want to help stabilize gasoline prices, create good paying jobs, and make the U.S. less reliant on unstable foreign governments for our energy as has been stated by administration after administration then the U.S. must maintain a consistent regulatory policy. Policy cannot be allowed to arbitrarily change every three to four years. If the U.S. can implement such a policy we can secure a brighter future for our energy security, our national economy, and our communities.

Mr. LAMBORN. All right. Thank you.

And Commissioner Spehar?

STATEMENT OF JIM SPEHAR, FORMER MAYOR OF GRAND JUNCTION, COLORADO, FORMER MESA COUNTY COMMISSIONER

Mr. SPEHAR. Thank you, Mr. Chairman.

I appreciate the opportunity to testify today before the Subcommittee and to submit the more formal written testimony with more detail for the record, which I have also done.

I was pleased, Mr. Chairman, to hear your emphasis on balance as we began this hearing and to hear Representative Tipton talk about creating win-win situations. My purpose here today is to talk a little bit about that from the standpoint of a former elected official and as a former member of the Colorado Economic Development Commission.

Six generations ago, my family came to western Colorado, to Crested Butte, to work on the extraction industries, mining coal and precious metals. Three times this month, my wife and I have

traveled there, encountering various roadblocks on Highway 15 on Kebler Pass.

While those delays frustrated me, my much more patient wife explained to me that there is sometimes a positive purpose to roadblocks. They warn of potential danger, the need for special attention and caution, and they provide information to successfully navigate a change for a changing situation. And they protect us and others, including those working to make the changes.

The same could be true of the roadblocks some complain about regarding oil shale. I am reminded of the well-known saying that the four most expensive words in the English language are, "This time it's different."

From my experience working in and observing this latest development cycle, I know this is not the industry of 30 years ago. Many different technologies are being researched this time. The pace and timing is more cautious and deliberate.

But some lessons from the time between disproven expectations and the devastation that followed last time do apply, and I wonder if we have learned them. Where is the necessary preparation to host this industry if it does emerge? Do we prudently plan, identify impacts and how to handle them, or struggle and suffer as northwest Colorado did three decades ago, a time, when, according to then-Governor Dick Lamm, it was like trying to change a tire on a car that was moving.

There is no need to risk making northwest Colorado and neighboring oil shale areas a national sacrifice zone once again. There is still time to be strategic without compromising development of an oil shale industry. We have been chasing this rock that burns, this fuel of the future for more than a century now, 10 years at a time.

It was 10 years when I began consulting with Shell in 1997. It was 10 years when that work ended for me in 2003, and it was still 10 years when I heard a presentation at the Mahogany test site last fall. In presentations, hearings, and symposiums in Utah and Colorado over the past few months, I still heard industry representatives estimate it will be 7 to 12 years before a commercial-scale oil shale industry might develop.

That means there is time for the comprehensive impact studies that are as important as the science projects underway at research, development, and demonstration sites. These studies are vital if development is to be, as Shell and others have repeatedly promised, economically viable, environmentally responsible, and socially sustainable.

Decades of creating nurturing and diversified economies need to be honored and supported. Taxpayers and their communities are just as deserving of certainty as the industry is. Whether we support or oppose oil shale development, it is irresponsible not to be planning now for that potential development and its impacts. To do that, we need comprehensive planning and preparation. However, the BLM's own 2008 programmatic environmental impact statement confirmed the lack of adequate current information to do that.

We need the resources to manage upfront impacts and help provide a soft landing if, once again, things don't pan out. But there

has been no discussion of creating an oil shale trust fund, which did both last time.

We need to assure current taxpayers they are not expected to increase their burden to finance the needs of the industry. But instead, we see proposed reduced royalty rates that would deprive communities of funding. As you know, just under half of those royalties flow back to State and local governments. I suspect Congress will not be anxious to defer its 51 percent and let all of the communities remain whole.

We need to assure a reasonable return to taxpayers on the use of Federal lands but, instead, propose commercial leasing before technical research proves the need and the market helps establish an appropriate lease rate. We need to protect and provide for current sustainable economic drivers, such as agriculture, hunting and fishing, tourism and recreation, each with multimillion dollar positive current impacts and thousands of existing jobs.

We need to all have realistic expectations for a potential industry, which, in my experience, is just as anxious to manage exuberant promises as anyone.

In 2000, while I was on the city council, Grand Junction and other local partners funded an effort to define our future. That was known as Vision 2020. Among other things, 1,200 face-to-face interviews were conducted here in Mesa County. Nearly 20 years after the fact, "black Sunday" was still seen as the defining moment in this community's history.

We need to cooperate in developing a "no regrets" strategy if the oil shale industry is to be successful this time, gather the full range of necessary information, and provide financial and other resources to implement prudent planning, all that if we are to make certain we have learned the lessons of that painful past. We should consider that an opportunity and a challenge, not a roadblock.

Thank you for the opportunity to talk about the needs of our communities, and I look forward to answering any questions you may have.

[The prepared statement of Mr. Spehar follows:]

Statement of The Honorable James G. Spehar, Former Mayor, Grand Junction, Colorado, Past President, Colorado Municipal League

This written submission and my oral comments before the U.S. House of Representatives Subcommittee on Energy and Mineral Resources at its field hearing on "American Jobs and Energy Security: Domestic Oil Shale the status of Research, Regulation and Roadblocks" in Grand Junction, on August 24, 2011, are informed by several perspectives.

They include coming from a six-generation western Colorado family that originally emigrated to the Western Slope to work in extraction industries; former responsibilities as an elected Mesa County Commissioner and as a city council member and Mayor of Grand Junction; work with other communities as a past president of the Colorado Municipal League and former board member of Associated Governments of NW Colorado; work within state government on growth and development issues and as a former member of the Colorado Economic Development Commission; and helping direct local economic development efforts as a past board member of the Mesa County Economic Development Commission (now the Grand Junction Economic Partnership).

It also results from 15 years of consulting work on growth, energy and economic development, and job creation issues w/local governments, their regional associations, state agencies, multi-national energy companies and others. That includes six years of contract work on oil shale and community issues for one of the early lessees in the federal government's oil shale research, demonstration and development pro-

gram. I have worked with the Colorado Department of Labor and Employment on workforce issues in rural Colorado and helped directed a collaborative multi-county effort on regional socio-economic issues that included portions of NW Colorado that will be directly impacted should a commercial oil shale industry develop.

Given that background, I applaud the efforts of Congress and the subcommittee to investigate the role an emerging oil shale industry might play in job creation and providing the "home grown" energy resources to fuel employment growth and to help move our nation toward energy self-sufficiency. The purpose of my oral and written testimony is to make certain other important parts of that equation are given equal consideration as we move forward.

Whether you oppose or support oil shale development, it's irresponsible not to be planning now for potential development and the possible impacts.

That examination of impacts demands more than just a science project. But current research is focused primarily on technology, not the broad range of social, economic, environmental and other community impacts that will result if the technical research is ultimately successful.

Just as the industry desires certainty in what's required of it, so do communities deserve that same degree of certainty as to what the expectations of will be of their local governments, non profits and other agencies, schools, hospitals, for infrastructure and services associated with the development of this industry.

Similarly, this added use on public and private lands, its water and power requirements and potential impacts to air quality, will impact many existing multi-million dollar industries that also provide important jobs, including but not limited to agriculture and other water users, tourism and outdoor recreation, even natural gas and other existing extractive industries. We should be careful that we are not merely swapping jobs and that new employment does not come at the expense of existing job providers in already active and sustaining industries important to the economic well-being of the region.

The BLM's own 2008 Programmatic Environmental Impact Statement (PEIS) acknowledges the lack of then-current information available regarding many of these issues. Subsequent analysis has served both to inform and confuse matters identified as uncertainties in the PEIS and the current review and potential update of that document ordered by Interior Secretary Ken Salazar will hopefully fill in some of the blanks.

For several years now, I've been part of an informal NW Colorado group of current and former local elected officials, wildlife and agriculture interests, water organizations and others who've been working with our congressional delegation since the summer of 2009 to see that these sorts of impacts are quantified and addressed prior to any commercial leasing. We most recently met with Representative Tipton in February of this year and hope to continue these discussions with him, with Senator Mark Udall and with Senator Michael Bennet.

The Colorado delegation, on our behalf, has twice forwarded to the DOI our request that an independent study of cumulative impacts of oil shale development be completed prior to any commercial leasing. (See Attachment A).

A written reply to Sen. Mark Udall dated March 24, 2011, sent on behalf of BLM Director Bob Abbey, indicates that sort of investigation will be part of the PEIS review now in progress and is a welcome next step in the process of prudently planning for the possibility of an oil shale industry. (See Attachment B).

The Associated Governments of NW Colorado, a regional association of municipal and county governments in the region, a few years ago commissioned a cumulative impacts study of development and population growth in the same geographic area that is ground zero for this potential industry. (See Attachment C.)

That study, entitled "Northwest Colorado Socio-Economic Analysis and Forecasts " and released in 2008, likely already needs updating but provides an excellent outline of the sort of information local communities need in order to plan intelligently if they are to host commercial oil shale development, whether a decade or more from now or in some shorter time frame.

There is still time to answer the important outstanding questions regarding how local communities expected to host oil shale development can manage associated impacts. As outlined in the attached report "Secure Fuels from Domestic Resources: The Continuing Evolution of America's Oil Shale and Tar Sands Industries" prepared by INTEK, Inc., for the U.S. Department of Energy Office of Petroleum Reserves and released in September, 2010, all of the players active in oil shale development envision multi-year research and development scenarios. In recent months and in various settings, major players in this region have estimated time frames of 7–12 years for development of commercial-scale technologies. (See Attachment D).

If that time frame is shorter, or if some sort of new crisis in the Middle East or elsewhere accelerates the schedule, it's even more imperative that this sort of addi-

tional information over and above the "science project" technology be made available and appropriate steps to mitigate impacts be put in place before commercial leasing and development take place.

Here are some of the questions that need to be answered in the context of the subject matter of this hearing:

(1) Should development of an oil shale industry be subsidized either directly, via government funding or product purchases, as has been done in previous cycles, or indirectly, via reduced royalty rates as anticipated in the Energy Policy Act of 2005?

(2) Should large-scale leasing of federal lands for commercial oil shale production proceed, as anticipated in the Energy Policy Act of 2005, prior to successful demonstration of commercial-scale processes for production of fuel from oil shale?

(3) How can the federal, state and local governments, the industry, and other partners make certain impacts of oil shale development do not fall unreasonably on current taxpayers and not negatively impact important sustaining industries?

(4) What role does the federal government play in maintaining realistic expectations of companies involved in oil shale research and development and in creating realistic expectations on the part of a public justifiably anxious about U.S. energy security and concerned about job creation.?

It is important to remember the lessons of the past, when understandable haste and federal subsidies fostered the oil shale boom of the late 1970s-early 1980s. Thousands of workers followed that boom to northwestern Colorado, overwhelming infrastructure, taxing services, and artificially inflated the economy. Just a few years later came the infamous "Black Sunday" when thousands lost their jobs, communities became ghost towns, and a decade or more of struggle began to regain economic balance.

Helpful in dealing with that previous boom and bust was the Oil Shale Trust Fund, designed to assist industry in helping communities front the up-front impact costs that come prior to receipt of tax revenues. That fund, filled by advance payments against future royalties, also helped provide a somewhat softer landing after the bust, maintaining payments on infrastructure built in anticipation of a long-term industry and funding economic development aimed at diversifying jobs and industry in the region.

There's been no talk of such a trust fund as we again look at what Rep. Tipton cites as the potential for 350,000 new jobs in a new oil shale industry.

Equally concerning is the provision in the Energy Policy Act of 2005 cutting initial oil shale royalty rates by more than half. As subcommittee members know, slightly less than half of royalty payments are returned to states and local governments where the activity occurs. Reducing those rates diminishes the ability of local communities to provide infrastructure and services a new industry finds necessary to create and sustain jobs.

Congress needs to understand that direct correlation and become an active partner with the states and their local governments in dealing with impacts should a new oil shale industry come to fruition.

Now we are hearing calls for large-scale commercial leasing as another incentive for kick-starting the industry. Two mayors of the region's largest cities raised important questions regarding that issue just a few days ago on the op ed page of the Grand Junction Daily Sentinel. "If there is no proven commercial process, wouldn't this foster speculation," they asked. "Should research be successful, won't it then be easier to make certain lease rates reflect the appropriate value to the public?"

Equally concerning is the lack of comprehensive analysis of the impact of this potential new industry on existing jobs and industry. Air quality, water demands, land use changes have the potential to, as the BLM states in the operative PEIS for oil shale research and development, to cause the region to morph from its traditional agricultural, tourism, hunting and fishing and recreation economies, all of which provide important sustaining jobs, to an industrial zone.

As an example, water issues alone raise enough issues to demand a thorough examination before rushing development of an oil shale industry. Estimates of potential water demands vary by a factor of three, from 120,000 acre-feet per year to nearly 380,000 acre-feet. Even if industry utilizes water it already owns, exercising those senior rights could have a dramatic effect on junior users in other industries.

If additional water is necessary, it comes from a Colorado River Basin some say is already at maximum capacity. Others who count on some unallocated water in the river say that, even at the lowest estimated demand for oil shale, that would take up half of Colorado's allocation of the water remaining in the Colorado River.

No one likes to consider these sorts of things as a "worst case" scenario when we are all in favor of good jobs, energy independence and a more promising future.

Seeking definitive answers to these important questions should not been seen as a roadblock to oil shale development but instead as necessary strategic planning to insure a viable and sustainable future.

But prudence would seem to dictate we develop a "no regrets" strategy that, as much as humanly possible, avoids the well-documented mistakes of the past, and assures local communities are prepared and adequately funded to deal with associated impacts of oil shale development.

In conclusion, I would urge this subcommittee to expand its agenda to also include examination of the steps necessary to make certain the entire range of questions concerning development of a successful oil shale industry that might contribute to both job creation and energy independence. Only in that manner can we all be assured that oil shale will be a welcome and meaningful component our energy security and create new jobs without compromising existing economic drivers and our treasured way of life in northwest Colorado, northeast Utah and southeast Wyoming.

[NOTE: Letters submitted for the record by Mr. Spehar follow:]

[A letter to Secretary of the Interior Ken Salazar dated November 18, 2009, follows:]

Congress of the United States
Washington, DC 20515

November 18, 2009

Honorable Ken Salazar
Secretary
Department of the Interior
849 C Street, NW
Washington, DC 20240

Dear Secretary Salazar,

We are writing concerning the need to objectively answer critical questions about potential impacts of large scale commercial oil shale development on water, communities and local economies before proceeding with commercial development. The Bureau of Land Management (BLM) concluded in its September 2008 programmatic environmental impact statement on oil shale that the agency lacks the information necessary to meet Congress' mandate in the Energy Policy Act of 2005 that "development should be conducted in an environmentally sound manner, using practices that minimize impacts." In advance of sufficient information to manage risks, commercial development of oil shale could irreparably change local lives, local economies and the environment.

The most recent evaluation of the viability of oil shale technologies was prepared in 1980 by the Congressional Office of Technology Assessment. Despite BLM's attempt to address this deficit through the research, development and demonstration (RD&D) program, there are questions that need to be answered to bring necessary clarity regarding how industrial scale oil shale operations could impact the region and the nation – questions that cannot be answered by the current scale of research.

The best way to gain answers to critical questions is to proceed in an orderly fashion. That means allowing RD&D to be completed and the data analyzed prior to offering leases for commercial development. It would also be advantageous for RD&D programs to be supplemented with an independent evaluation conducted by the National Academies of Science (NAS). The NAS study should investigate, among other things,

- The status of oil shale extraction technologies;
- The likely positive and negative implications of the various technologies for the production of kerogen from oil shale resources;
- The cumulative energy and water inputs required to produce oil from shale, including a lifecycle assessment of greenhouse gas emissions produced;
- The cumulative economic and environmental impacts of commercial-scale oil shale production and associated energy infrastructure required for the commercial application of the various oil shale technologies currently in operation or under development on energy and water resources;

- The timeframe for viable large-scale commercial oil shale production and events that should serve as a precursor to commercial leasing, such as development of commercially viable and environmentally safe technologies;
- Workforce capacity requirements associated with commercial-scale development; and
- Means of ensuring a fair return to the public from the production of oil shale on public land.

We applaud your recent decision to seek answers concerning the effects of oil shale development on water quantity and quality, other environmental effects and socioeconomic factors. It is our view that sound RD&D, along with an independent NAS evaluation, offers a judicious approach to the prospect of commercial development of oil shale. The scope and funding of an independent analysis by the NAS would provide a scientific base for future decisions and we hope you will join us in supporting that effort.

Sincerely,

Mark Udall
U.S. Senator

Michael Bennet
U.S. Senator

John T. Salazar
Member of Congress

[A letter to Secretary of the Interior Ken Salazar dated December 17, 2010, follows:]

United States Senate
WASHINGTON, DC 20510

December 17, 2010

Honorable Ken Salazar
Secretary
Department of the Interior
1849 C Street NW
Washington, DC 20240

Dear Secretary Salazar:

We are writing to follow up on our request of December 19, 2009, concerning the need to objectively answer critical questions about impacts of large scale commercial oil shale development on water, wildlife, communities and local economies. We have once again heard from a diverse group of local constituents in northwest Colorado who continue to seek a comprehensive study of those potential impacts prior to consideration of any commercial oil shale development. Those constituents include local government officials, ranchers, water and wildlife interests and others.

As we noted in our previous request, the Bureau of Land Management (BLM) concluded in their September 2008 Programmatic Environmental Impact Statement on oil shale that the agency lacked information to meet the congressional mandate in the Energy Policy Act of 2005 that "development be conducted in an environmentally sound manner using practices that minimize impacts." In addition, on November 29th 2010, the General Accountability Office released a report on the potential impacts to water of oil shale development, finding that oil shale development could have significant impacts on the quantity and quality of water resources and recommending that the Department of the Interior initiate water-related research with DOE and state agencies involved in water regulations.[1]

While we and our constituents are appreciative of your efforts in the second round of research, development and demonstration (RD&D) leasing to require that information developed on those leases is more accessible and timely, the fact remains that the RD&D program is focused more on technology and processes than on potential impacts on land, water and people. That additional information is critical to responsible planning by local and state governments and federal and state agencies.

As we requested in our 2009 letter, we ask that RD&D be completed and the data analyzed prior to considering offering leases for commercial development. We also continue to believe that information from the RD&D program must be supplemented by an independent evaluation conducted by the National Academy of Science (NAS) that investigates, among other things:

- The status of oil shale extraction technologies;
- The likely positive and negative implications of the various technologies for the production of kerogen from oil shale resources;
- The cumulative energy inputs required to produce oil from shale;

- The cumulative economic and environmental impacts of commercial-scale oil shale production on energy and water sources and associated energy infrastructure required for the commercial application of various oil shale technologies currently in operation or under development;
- The time frame for viable large-scale commercial oil shale production and events that should serve as a precursor to commercial leasing, such as development of commercially viable and environmentally safe technologies;
- Workforce capacity requirements associated with commercial scale development and the potential impacts of assimilating those workers and their families; and
- Means of ensuring a fair return to the public from the production of oil shale on public land.

Given the lack of current relevant information, any move toward commercial leasing should occur only in concert with a thorough comprehensive analysis of cumulative impacts that would provide the Department of Interior, other relevant federal and state agencies, and local and state governments the means to make informed planning decisions.

We and our constituents recognize the challenges of funding such a study in the current economic and budgetary climate. Therefore, we ask only that you adopt now a policy requiring this type of analysis be completed prior to implementing any commercial oil shale leasing program. They and we pledge to work with you toward scoping and seeking funding for this independent study by NAS as economic conditions improve.

Only by proceeding slowly and judiciously and with current comprehensive information can we be assured that not just technological questions but the broader issues of water needs and impacts, socio-economic impacts, environmental impacts and other impacts can be planned for and mitigated in a manner that leaves local communities and surrounding lands both healthy and prosperous and diminishes the chances they will be devastated by another boom and bust oil shale cycle.

We look forward to your positive response and to working with you and your department on this important issue.

Sincerely,

Senator Mark Udall

Senator Michael F. Bennet

[A letter to Senator Mark Udall dated March 24, 2011, follows:]

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Washington, D.C. 20240
http://www.blm.gov

TAKE PRIDE IN AMERICA

MAR 24 2011

The Honorable Mark Udall
United States Senate
Washington, DC 20510

Dear Senator Udall:

Thank you for your December 16, 2010, letter to Secretary of the Interior Ken Salazar regarding oil shale development in Colorado. Secretary Salazar has asked me to respond to your letter.

I understand your concerns about how large-scale commercial oil shale development might affect water, wildlife, communities, and local economies. Any oil shale development must include careful analysis and consultation with all affected stakeholders.

Your letter discusses the Bureau of Land Management (BLM) 2008 Programmatic Environmental Impact Statement (PEIS) for oil shale. In 2008, the BLM published a Final PEIS and Record of Decision that amended eight land-use plans in Utah, Colorado, and Wyoming to make nearly two million acres of public lands available for potential commercial oil shale development.

The BLM is initiating a process to take a fresh look at the 2008 decisions. The public planning process will allow the BLM to update its assessment of what public lands are best suited for oil shale development. The public will be invited in the planning process to submit their comments and concerns, and final land-use decisions will be made in light of any new information about potential resource needs and impacts, as well as any new technological innovations. The BLM is also initiating a public rulemaking process to consider, among other things, whether plans of development for commercial oil shale leases must include specific watershed and groundwater protection plans, airshed reviews, integrated waste-management plans, or environmental protection-and-mitigation plans.

Meanwhile, the Department and the BLM remain committed to a robust program of research and development. The BLM recently completed its review of three nominations for oil shale Research, Development, and Demonstration (RD&D) leases in Colorado and Utah. An Interdisciplinary Review Team, including representatives of the Governors of Colorado, Utah, and Wyoming, the Department of Energy, and the Colorado School of Mines, recommended that all three nominations be advanced. The BLM's Colorado and Utah offices will conduct National Environmental Policy Act reviews on the nominations, two of which are in Colorado and one of which is in Utah. The analyses may take up to 18 months to complete, and will help chart an informed path for oil shale resources in the West.

This second round of 10-year leases would help answer fundamental questions about the feasibility of oil shale technologies, their impacts on the environment and local communities, and the use of water — all important issues cited in your letter. This RD&D round contains substantial diligence requirements, including specific timeframes for submitting plans of development, obtaining state and local permits, developing infrastructure, and submitting quarterly reports.

After obtaining sufficient information from the leases, the data will be available for evaluation by independent entities, such as the National Academy of Sciences, to help provide a scientific basis for future decisions on development. I appreciate and will consider your offer to help seek funding for such a study in the future.

Your letter restates your 2009 request that the BLM complete the RD&D process and analyze the data before considering offering leases for commercial development. Before issuing leases on any nominated parcels, the BLM must comply with NEPA to ensure consideration of possible environmental consequences from commercial development, as well as any appropriate mitigation. During the NEPA process, the public would have an opportunity for input. As always, the BLM is committed to working with affected stakeholders, including state and local governments, Tribes, and the public when considering energy issues on public lands.

Thank you for your interest in and support of responsible oil shale development. A similar letter has been sent to Senator Michael Bennet. If you have further questions or concerns, please contact me at 202-208-3801.

Sincerely,

Robert V. Abbey
Director

Mr. LAMBORN. Well, thank you all for being here. You have provided various kinds of illumination and education for us, and I appreciate that. We are going to launch into the first round of questions.

Mr. Whitney, you talked about the PEIS, the preliminary environmental impact statement, and you gave a very diametrically different description of that than Ms. Hankins did earlier this morning. She said there had been all these new things going on that had come to light that justified it, whereas you say that—and Mr. Aho, you said the same thing—that there has not been anything that has changed in 3 years.

And Mr. McCloud, you may have said that as well—other than political changes in Washington. So which is it? I mean, I am confused here. I am mystified.

Mr. WHITNEY. Well, as I said, we do believe there is no reason to revisit the PEIS. Shell believes in a transparent and regulated NEPA process, the National Environmental Policy Act process for potential commercial projects.

When a successful RD&D pilot is completed, an application for conversion would be submitted that would include a description of a commercial project that would be used to work through the NEPA process. And that is when specific environmental concerns and socially sustainable issues can be addressed.

Shell's ultimate goal is to create a commercial oil shale recovery operation that is economically viable, environmentally responsible, and socially sustainable. The exact scale and timing for development will depend on a number of factors, including regulatory stability.

The PEIS is just a key element of the regulatory framework that oil shale industry needs to move forward.

Mr. LAMBORN. Yes, and I meant to say programmatic EIS.

This issue of it is always 10 years out in the future, your company has one of the major demonstration projects, research projects going on here, which I have visited in the past. And I have had discussions—I don't want you to feel compelled to give anything that is proprietary to your company. But cost effectiveness is obviously a big issue.

And with the rising and then lowering and then rising price of oil, an expensive technology because it is more complicated, more time intensive and everything else, at some cycles in the oil prices will not be profitable. At other times in the cycle, it will be profitable.

Is this a technology that is always going to be 10 years away and never, ever materialize? I have heard that many times today and in the past. Or will we reach a point at some point with oil around the world becoming harder to access, more expensive to produce because we are going into deeper waters or troubled areas politically, or other things like that? What does your company think about the ultimate viability of oil shale oil production?

Mr. WHITNEY. Shell supports the RD&D program. In general, if a regulatory environment exists that awards numerous companies leases and a framework exists where a stable, long-term regulatory environment is well understood, then industry has the best chance of truly assessing how economically viable, environmentally responsible, and socially sustainable it can create—the projects that they can create.

So, there is no definitive answer. The framework just needs to exist for industry to put its shoulder against it and see if we can solve the problem and make oil shale a robust business for the future.

Mr. LAMBORN. So you are convinced that at some point, the break-even point will be reached and exceeded to make this an ongoing proposition?

Mr. WHITNEY. Yes, sir.

Mr. LAMBORN. I will just state for the record, I, for one, would rather have a private company making this investment, as opposed to taxpayers being on the hook. As long as the environment is being protected, I would rather see private corporate dollars being invested, and you and I, as taxpayers, don't have to make that investment, as has been the approach in the past.

That is my time for now. Representative Tipton?

Mr. TIPTON. Thank you, Congressman Lamborn.

Listening to some of the testimony, and Commissioner Spehar and I have probably some of the longer history on this side of the West Slope, it is kind of like "Groundhog Day," that old movie?

[Laughter.]

Mr. TIPTON. You know, it is the same thing being played over and over again many times. When we are talking about it is always 10 years out, I recall back with the development under President Carter, the Department of Energy, a lot of our moves to move, to the best of our ability, to energy self-sufficiency in this country, it was always 10 years out.

I would just like to have you maybe perhaps comment. Has part of that been political failure out of Washington, D.C., in particular, to be able to have that political will, to be able to actually achieve the goal? And if you would just maybe comment on that, I would appreciate it.

You are up first, Mr. Whitney.

Mr. WHITNEY. All right. Like I said, Shell supports the RD&D program. The way that that program works, of course, is, like I said, based on a successful pilot, an application for a conversion is submitted that describes the commercial project that would be moved forward through the NEPA process.

So, indeed, the process will work. We just need to give it time and make sure that the business environment and regulatory environment allows things to move forward in a systematic, clear way. The more companies are awarded leases, the more companies are progressing their research and development, the more likely we are to be successful in finding a commercial path forward for oil shale.

Mr. TIPTON. Anyone else care to comment on that?

Mr. AHO. Well, you know, the idea that shale is always 10 years away, some of that is driven by low supply and demand for oil. And obviously, as the world population grows and the increased demand is now on the world scene and our oil supplies are gradually decreasing, we are reaching a point where our supply will not be able to meet demand, and we will see increased pricing of oil. Of course, we are seeing that today.

So it comes to a point where there is a break-even point for the production of shale oil where it does become economic. And some of the companies are talking $50-$70 range. From the country of Estonia that just moved into Utah, they look at their break-even, including their return on investment, is at $70 a barrel.

So they are making great strides to begin that project in Utah with the idea that they have a technology that works in Estonia. They intend to bring that to the United States and look at commercial development on that project.

So, I think we are reaching the point where on the world scene, we don't expect the price of oil to drop much below—certainly not below $70 a barrel. Some people think it could go back there for short periods of time.

But the lead time involved in these projects is crucial for people to understand. Even the project that we are working on in Utah, that project which is aligning conventional surface retorting, they are looking at 4 to 6 years of permitting and environmental work in advance of construction. And their question becomes the uncertainty of the Federal regulations.

We are all stuck with this. What are the rules going to be 5 or 6 years from now? We don't know because they are not what they were 5 years ago, and they are not what they were 30 years ago

when I started in this business. This uncertainty is what is driving us crazy.

Also, and we have talked about today all these Federal programs that need to get lined up. But frankly, when a corporation gets a lease, and they begin the permitting process, we always have to put together a detailed development plan and go through a detailed permitting process that will address water supply. Corporations are not going to invest millions of dollars without an assured water supply.

They are not going to get into a project where they haven't dealt with all of the local stakeholders in order to get the permits. There is a whole process that corporations have to go through. So just assigning somebody a lease doesn't give them the green light to build a plant.

Thank you.

Mr. SPEHAR. Representative Tipton, I agree with you. I think none of us could say over decades that we have had a consistent energy policy, and certainly, that is, I think, part of the problem. But I think it is also true that I expect this industry will be developed. That is why I am concerned about a head start on dealing with impacts and so on.

As it has been explained to me in my work over the years, particularly the major energy companies know that new supplies of conventional oil are harder to find and more expensive to develop and produce. That is why they are investing admirably in alternative technologies, and one of them even helped do the energy conservation in the government buildings on this block.

But I think there will need to be a bridge between the new technologies and conventional resources and that these what are called unconventional fuels, like tar sands and oil shale, are one opportunity to provide that bridge.

I worry, though, because even at a mid-range scale, at a 500,000-barrel-a-day industry, the study done by Associated Governments of Northwest Colorado that I refer to in and attached to my written testimony, anticipates population growth in excess of normal population growth of about 50,000 in just the three counties in northwest Colorado. That is a huge bite for these communities to take on.

Current taxpayers shouldn't have to do the upfront development or upfront impacts for that. As you know, from your experience in our State Legislature, our tax structure here delays gratification. You know, if Gary builds a plant today, it may be reassessed next year. You may get the bill the following year, and the money may be collected the year after that. All that time he is building that plant is when most of the impacts occur.

So, that is why I suggest that we revisit the idea of the oil shale trust fund, where these companies would pay royalties in advance against future billing and provide that upfront scenario where money is available for communities to deal with these impacts.

Mr. TIPTON. I appreciate your comments on that.

And Mr. Whitney, can you give us an idea, and we are going back to 10 years down the road, 10 years down the road, has your business at Shell taken a look and said have we had a consistent regulatory policy? This is where we could have been?

Are there any sorts of those types of estimates, or do you feel like you get to wake up in a whole new world every morning when it comes to regulatory policy and then try and move the ball forward from there?

Mr. WHITNEY. In general, we just try to communicate clearly that a stable, long-term view and stable regulatory policy is very important for industry. And indeed, change does happen, and we always are forced to deal with that.

But when we see change on the horizon, that is when we really want to communicate more clearly and make sure that people really understand that the things that they are considering, are they addressing them in the right way? Is the PEIS the right way to deal with it, or is it the NEPA process?

What is the best way to address the concern, and how do you get it done in the appropriate regulatory environment?

Mr. TIPTON. I think that certainly goes to Mr. McCloud's comments in terms of companies must be provided with the path to commercialization. I think that was your comment.

Mr. MCCLOUD. Exactly. Actually, if I can, Representative Tipton? One of the things that the BLM stated when they reissued the PEIS and one of the rationale was that there was not an economically viable way yet known to extract and process oil shale for commercial purposes.

By continually moving the parameters or not offering set, clear guidelines and policies, that is rather a self-fulfilling prophecy. Being a businessman, and people involved in business know that you have certain things you have to consider when you are putting together your business model and your business plan.

You have to look at what your return on investment is, how is it potentially profitable, the different environmental, social, and economic considerations. Is it sustainable? And those are just a few of the things that you have to consider when you are putting those policies together. But if you can't maintain a stable regulatory environment to do that within, you can't build a business model that you are going to have for future needs down the road as well.

The biggest thing we have to consider if it is going to be economically feasible, if you look at the U.S. Energy Information Administration, they reported that by 2035, even with aggressive use of hybrid, electric, hydrocarbons, natural gas, 93 percent of the vehicles in the United States are still going to run on oil.

So, by that same year, 2035, they estimate that the consumption, the world's oil consumption will be up by 30 percent. The thing is on supply and demand, at least now oil shale works to be a bridge fuel in that middle.

Mr. TIPTON. May I ask one more? I kind of ran through both my series of questions.

Mr. LAMBORN. OK. Sure. Go ahead.

Mr. TIPTON. But I would like to return back to the comment I was making to Ms. Mittal in the previous panel in regards to a static versus a dynamic model in terms of looking forward. I believe it is the Moore's principle, you know, we apply that to technology in terms of it reducing costs.

It has been my experience in my business that we are able to at least create efficiencies. Would that be unexpected once we get this

development process going, that we are going to be able to create efficiencies?

If we are looking at the $70 barrel model, the Estonian model, that actually with American inventions, American creativity, and entrepreneurship, that we can probably anticipate that we would actually see those production costs lower, reducing, and a more affordable product for American consumers?

Mr. WHITNEY. Yes, sir. We call that a learning curve. If we look back at history—I will just use a couple of examples—it consistently takes around 30 years for new forms of energy to achieve about a 1 percent market share. Biofuels is just now reaching 1 percent, and it is because of the number of companies and the number of tries that have been taken to make it a viable fuel on the world supply market.

Wind. Wind took about three decades and may get to the 1 percent mark in the next few years. The very first wind farms, large ones, were built in Denmark and here in the United States. But it still took that incredible amount of time and investment to go down the learning curve to make it a viable alternative source of energy.

Mr. AHO. You are right. I think what we are looking at today, we call "first generation" or "second generation" retorting concepts. These will all continue to evolve.

Corporations are in the business to make money. So when they look at reducing cost of production, we are doing that day in and day out, whether it is the amount of water we use. And our objective is to get water use to a minimal amount because water costs us money.

Anything we are doing in a project of this nature, this is a capital-intensive industry. A shale oil project that will produce 50,000 barrels per day, we are talking—again, it is the model with mining and surface retorting—roughly $4 billion. And on a 50,000-barrel-per-day plant, we are looking at roughly 25-to-1 on barrels produced per worker. The question was raised earlier.

So a 50,000 barrel per day plant would employ roughly 1,900 to 2,000 permanent employees. Plus then there are the service industries and families and so forth. We are looking at that 2,000 being the population of 8,000 in an area. Kind of brings up what Jim was talking about earlier that certainly socioeconomic impacts are an issue that corporations deal with when they look at permitting one of these projects.

Will there be enough trained workers in that region? How are we going to support our employees? How are we going to provide housing?

So we work together with the local economy and the counties to try and mitigate that impact. That is part of the permitting process. Corporations are not going to get permits to build a plant if they haven't dealt with mitigation issues that surround it.

So, thank you.

Mr. TIPTON. Thank you.

Mr. LAMBORN. All right. Thank you, Representative.

And to conclude now with the last couple of questions, Mr. Whitney, what is your company doing to concentrate on the important

issue of reducing water consumption and using more recycling should the RD&D project be successful and you go forward?

Mr. WHITNEY. Shell understands how important water is to the Western Slope and Western States. Shell is committed to using water responsibly. To date, Shell has purchased or appropriated a diversity of water rights, in accordance with Colorado law.

Shell's overall water management strategy involves three key aspects, all aimed at minimizing the quantity of water used and negatives impacts to other users. So the first one is maintaining a diversity of water rights to provide our operations the flexibility of alternative sources and to minimize the impact on existing and traditional users.

Second, it is optimizing our oil shale recovery and processing technologies to reduce the amount of water required. And third, applying best water management practices in our operations, such as water treatment, storage, and reuse wherever practical. In a commercial operation, we will have staff dedicated to water management and optimization.

Mr. LAMBORN. OK. Thank you.

And Mr. McCloud, we have talked a lot here today about some of the concerns such as water and other things that we really have to watch closely about. What do you see, on the other hand, are the upsides, both locally and nationally, should these projects be successful and they go forward on a commercially viable scale?

Mr. MCCLOUD. We feel that those benefits become relatively obvious. If we have a potential industry that could create potentially 100,000 jobs roughly, not only is that good-paying jobs that we need here in the United States to help those unemployment rates, but we also create a tax base to support our local and Federal and regional governments.

That, in turn, obviously, helping with our infrastructures, our schools, community support programs, et cetera. It should be, to use a term from earlier, self-fulfilling in the fact that if we can get those processes and that industry here, we will be able to create the revenues to support the communities like we would like to.

Mr. LAMBORN. OK. Mr. Spehar?

Mr. SPEHAR. Well, again, I don't need to remind you, given your Colorado experience, that it is an issue of timing and when those revenues become available and if there is adequate funding in the early stages while the impacts are the greatest to make sure that the burden doesn't fall on the backs of taxpayers in existing communities.

And there is a piece of that that we haven't discussed. I have a great deal of faith in a thoughtful and measured research process. It will give us the answer, yes or no, and I have no real concern about that going forward.

My concern is this, and maybe we ought to all check our iPhones and see where Gaddafi is right now. But if Hugo Chávez wakes up on the wrong side of the bed or we have some new crisis in the Middle East, and supplies tighten dramatically, and we get back in that kind of Jimmy Carter era scenario, all bets are off.

And unless we have done what I have suggested and, in the process of this research, identified how we are going to deal with impacts, then we are going to be chasing our tail, and we will be back

in that scenario of 30 years ago, even though this is a different industry and a different technology today. So that, if anything keeps me awake, that is it.

Mr. LAMBORN. All right. Well, thank you all for being here.

As we wrap up, I want to thank the crowd, for the people gathered here for being so polite and attentive. Maybe the best crowd I have ever seen.

[Laughter.]

Mr. LAMBORN. Or one of the best. So thank you as well.

For the witnesses, members of the Committee may have additional questions for the record, and I would ask that you respond to these in writing.

Mr. LAMBORN. I would also ask unanimous consent to submit three additional pieces of testimony to today's hearing record.

Hearing no objection, so ordered.

[The additional testimony follows:]

Statement submitted for the record by Alan Burnham, Ph.D., Chief Technology Officer of American Shale Oil (AMSO), LLC

I am Dr. Alan Burnham, Chief Technology Officer of American Oil Shale Co. AMSO, LLC is a joint venture of IDT Corporation and Total, S.A., and holder of one of the first-round oil shale research, development and demonstration (RD&D) leases awarded by the Bureau of Land Management in 2007.

On behalf of AMSO, I thank you, Chairman Lamborn, and Congressman Tipton for holding this hearing on Domestic Oil Shale Research, Regulations and Roadblocks. It provided a good opportunity to provide an update on the status of oil shale RD&D activities.

In response to your hearing, an anti-oil-shale organization posted quotes from the hearing witness compared to predictions about the future viability of an oil shale industry with the intent of discrediting the witnesses as telling the same old (and incorrect) story. While it is appropriate to ask the question, "what is different this time?" This is an important question that deserves a thoughtful answer. The opponents presume that nothing is different. However, that presumption demonstrates a lack of understanding of both history and economics.

Production of shale oil from oil shale is not new. Shale oil was used for street lights in Italy in the 1600s. There was a British patent on oil shale retorting in 1694. Commercial lamp-oil industries started in France and Scotland in the mid 1800s to compete with whale oil. The Scottish industry lasted more than a century and employed up to 5000 miners. The Swedes produced a couple thousand barrels per day from surface and in-situ retorting after their fuel was cut off by the Nazis until 1966. The largest oil shale industry today is in Estonia, and it is profitable at current world oil prices. China also has a significant oil shale industry.

The reason shale oil is not being produced in the United States today is simple—it could not compete in the past with crude oil for any sustained period of time. Over the past century, a pending shortage of crude oil was predicted every 25 years or so, and interest in oil shale rose. However, oil shale was crushed every time by collapsing crude oil prices. The predicted oil shale boom in the 1920s was killed by crude oil discoveries in Texas. The oil shale boom in the 1970s was inspired by a high prices caused by a politically contrived oil shortage. That boom was killed in the early 1980s when crude oil prices collapsed due to a combination of reduced usage, North Sea oil, and Alaskan North Slope oil. OPEC's market share dropped from 50% to 30%, and OPEC's price-fixing power was neutralized.

So there are three real questions before us now: (1) are the current high oil prices a reflection of true demand pressure on achievable production levels, (2) will the situation get worse over the next couple decades as demand increases in the developing world while conventional crude oil production peaks, and (3) will alternatives such as electric vehicles and biofuels be able to beat shale oil on cost? We believe the difference in the situation today from the past is real, and oil shale will be economically competitive with the new sources of crude oil and with biofuels in the coming decades.

But what if we and other oil shale investors are wrong and oil shale really is fools gold after all? The answer is simple—we will lose our investment. It is not now nor ever has been the responsibility of the public to prevent companies from making bad

investments—it is not a topic worthy of public discussion. The public's primary responsibility is to be sure that any successful industry would be conducted in an environmentally acceptable manner. Environmental performance standards can be set to a large extent without a detailed understanding of oil shale technology, and they are basically in place today. It is industry's responsibility to meet those standards. That said, it is desirable to consider all such environmental standards in an intelligent manner that includes the cost-benefit ratio to society, but those tradeoffs are broader than the oil shale industry.

While industry has the responsibility for providing the capital and technical expertise for oil shale development, if it is in fact viable, the Federal government also has a unique role as the owner of the most and richest resource. Over human history, economic development has been optimized by producing the best known mineral resources of the day. And by law, the federal government has a responsibility to use the oil shale resource for the public good, which includes establishing a reasonable leasing policy. Oil shale leasing will not preclude the simultaneous use of the land for other purposes such as grazing and hunting. In fact, the oil shale industry can partner with the government to optimize the habitat for desired vegetation and animals.

Projected costs for in-situ oil shale are competitive other sources of unconventional fuels being produced today. The same cannot be said for biofuels, which exist today only because of governmental mandates and tax subsidies. If the United States had taken a longer term view for oil shale as Canada did for oil sands over the past few decades and the United States is doing today for biofuels, oil shale would be a commercially viable industry today supplying a significant fraction of our liquid fuels. While we cannot change the past, we can still influence the future.

That concludes our supplemental testimony. Again, we very much appreciate the Subcommittee's visit to Grand Junction last month, and we thank you for the important work you are doing to draw attention to federal oil shale and unconventional fuels policy.

Mr. LAMBORN. And if there is no further business, without objection, the Committee stands adjourned.

[Whereupon, at 11:26 a.m., the Subcommittee was adjourned.]

[A list of documents retained in the Committee's official files follows:]

- "Final Report: Northwest Colorado Socioeconomic Analysis and Forecasts," BBC Research & Consulting, submitted for the record
- Hrenko, Rikki Lauren, CEO, Enefit American Oil, Statement submitted for the record
- "OIL SHALE: America's Untapped Energy Source" prepared by the National Oil Shale Association
- "Secure Fuels from Domestic Resources: The Continuing Evolution of America's Oil Shale and Tar Sands Industries"; U.S. Department of Energy, June 2007

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