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U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON RESOURCES,
SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES

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Relating to Potential Development of
U.S. Oil Shale Resources
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Good morning Mr. Chairman and Members of the Energy and Mineral Resources Subcommittee:

My name is Terry O'Connor. I am Vice President of External and Regulatory Affairs for the Shell Unconventional Resources unit of Shell Exploration and Production Company. I am delighted to appear before you today to describe Shell's initiative to develop and advance, hopefully to commercial success, a unique and innovative technology which we are increasingly optimistic can open up the vast oil shale resources in the Western United States. This technology, once thoroughly proven technically, will allow Shell to produce clean transportation fuels such as gasoline, jet fuel and diesel as well as clean burning natural gas from oil shale in an economically viable and very environmentally sensitive fashion. Because the oil shale resource in the United States is extensive, this technology holds promise for significantly increasing U.S. domestic energy production.

For decades, energy companies have been trying, without success, to unlock the large domestic oil shale resources of northwestern Colorado, eastern Utah and southwestern Wyoming. Oil shale can be found in large parts of the Green River Basin and is over 1,000 feet thick in many areas. According to DOE estimates, the Basin contains in excess of 1 trillion recoverable barrels of hydrocarbons locked up in the shale. It is thus easy to see why there have been so many attempts to unlock this potentially enormous resource in the past.

Some 23 years ago, Shell commenced laboratory and field research on a promising in ground conversion and recovery process. This technology is called the In-situ Conversion Process, or ICP. In 1996, Shell successfully carried out its first small field test on its privately owned Mahogany property in Rio Blanco County, Colorado some 200 miles west of Denver. Since then, Shell has carried out four additional related field tests at nearby sites. The most recent test was carried out over the past several months and produced in excess of 1,400 barrels of light oil plus associated gas from a very small test plot using the ICP technology. We are pleased with these results, not only because oil and gas was produced, but also because it was produced in quantity, quality and on schedule as predicted by our computer modeling. With this successful test, Shell is now ready to begin work on the final tests that will be required to prove the technology to the point where there is sufficient certainty so as to make a decision to proceed to commercial development.

Most of the petroleum products we consume today are derived from conventional oil fields that produce oil and gas that have been naturally matured in the subsurface by being subjected to heat and pressure over very long periods of time. In general terms, the In-situ Conversion Process (ICP) accelerates this natural process of oil and gas maturation by literally tens of millions of years. This is accomplished by slow sub-surface heating of petroleum source rock containing kerogen, the precursor to oil and gas. This acceleration of natural processes is achieved by drilling holes into the resource, inserting electric resistance heaters into those heater holes and heating the subsurface to around 650-700F. over a 3 to 4 year period. During this time, very dense oil and gas is expelled from the kerogen and undergoes a series of changes. These changes include the shearing of lighter components from the dense carbon compounds, concentration of available hydrogen into these lighter compounds, and changing of phase of those lighter, more hydrogen rich compounds from liquid to gas. In gaseous phase, these lighter fractions are now far more mobile and can move in the subsurface through existing or induced fractures to conventional producing wells from which they are brought to the surface. The process results in the production of about 65 to 70% of the original "carbon" in place in the subsurface. The carbon that does remain in the sub-surface resembles a char, is extremely hydrogen deficient and, if brought to the surface, would require extensive energy intensive upgrading and saturation with hydrogen. Chart 1 illustrates the ICP process.

The ICP process is clearly energy intensive as its driving force is the injection of heat into the subsurface. However, for each unit of energy used to generate power to provide heat for the ICP process, when calculated on a life cycle basis, about 3.5 units of energy are produced and treated for sales to the consumer market. This energy efficiency compares favorably with many conventional heavy oil fields that for decades have used steam injection to help coax more oil out of the reservoir.

The produced hydrocarbon mix is very different from traditional crude oils. It is much lighter and contains almost no heavy ends. Its quality can be controlled by changing the heating time, temperature and pressure in the sub-surface. The production

mix generally seen from Colorado oil shale is about two thirds liquids and one-third natural gas and gas liquids such as propane and butane. On the liquid product side, the typical split encountered is about 30% each of a gasoline precursor called naphtha, jet fuel and diesel with the remaining 10% of the barrel being slightly heavier. These fractions can be easily transformed into finished products with significantly reduced processing when compared with traditional crude oils.
Because the ICP process occurs below ground, special care must be taken to keep groundwater away from the process, as its influx would seriously reduce thermal efficiency. Special care must also be taken to keep the products of the process from escaping into groundwater flows. Shell has adapted a long recognized and established mining and construction ice wall technology to isolate the active ICP area and thus accomplish these objectives and to safe guard the environment. For years, freezing of groundwater to form a subsurface ice barrier has been used to isolate areas being tunneled and to reduce natural water flows into mines. Where groundwater intrusion is a problem in the ICP process, the subsurface surrounding the rich oil shale layers is frozen to form a container of sorts, thus preventing the influx of water while at the same time containing the products formed. Shell has successfully tested the freezing technology and determined that the development of a freeze wall prevents the loss of contaminants from the heated zone. During this same test, Shell was able to demonstrate that traditional subsurface reclamation technologies such as steam stripping, pumping and treating and carbon bed stripping were able to remove contaminants developed in the ICP process from the subsurface to levels sufficient to meet stringent permit requirements. Though freezing the subsurface while simultaneously heating it is clearly a counter-intuitive application of technology, it is a good example of the creativity and unconstrained thinking that necessarily has been a major contributor to solving potentially vexing problems in this complex Research and Development project.
A schematic of the basic freezing technology is shown in Chart 2.
Because the ICP process involves no mining, no large or contaminated tailing piles are created. Water usage is expected to be considerably less than is required for traditional retort methods. Because the technology has the potential to recover in excess of 1 million barrels of oil per acre in the richest parts of the Basin, or about ten times that possible from conventional mining and retorting, temporary land disturbance associated with ICP during production will be significantly less. This smaller and cleaner footprint, the reduced water needs, the reduced processing needs, a robust system for protecting groundwater from contamination and the production of clean, less Green House Gas intensive products creates an environmentally attractive package about which we at Shell are very proud.
It is through well-established technologies and constant monitoring that Shell expects to ensure proper and transparent stewardship of the environment. Shell is already working closely with local communities, NGOs, elected officials, and regulatory agencies to ensure that our research addresses community needs and sensitivities while ensuring strong environmental protection.
Shell is currently focused on reducing the remaining risks and uncertainties that could affect the commercial viability of this technology. For this reason, Shell has a research staff in Colorado of approximately 55 personnel in addition to approximately 100 Houston and Denver based employees assigned to the oil shale project. The focus of these efforts is to insure the technical, commercial and environmental viability of the technology via a relatively large integrated demonstration project. This project would represent the final step required before a financial investment decision would be taken by Shell for a commercial scale unit.
While Shell has spent many tens of millions of dollars on research and development for this technology and has learned a tremendous amount while reducing risk and uncertainty, much work and expenditure still remain before the ICP process can be commercialized. Shell is anxious to proceed with ICP research so as to help unlock the significant potential that oil shale holds to increase indigenous energy supply in the United States. Achievement of this objective on a timely basis will require the active support of Congress and the Administration
Because the commercial development of oil shale would yield many benefits to the U.S. economy, Shell supports responsible policy initiatives that will facilitate early commercial production of shale oil and associated gas via methods that minimize industry's footprint and protect the environment. Shell is committed to working with Congress, with the Department of Energy, the Department of Defense, the Department of Transportation, the Department of Homeland Security and the Department of Interior, the latter of which has stewardship responsibility over approximately 80% of the oil shale bearing lands in the Green River Basin of the Rocky Mountain West, in order to accomplish this objective.
Key to the early development of oil shale technology is early access to appropriate Federal oil shale deposits to allow for pilot field tests to be carried out. The leasing of tracts of federal land to encourage research and development is an essential next step. As a private company, Shell supports appropriate lease terms and incentives for the development of new oil shale development technologies.
As the Department of Energy has pointed out in a recently released two volume report entitled "Strategic Significance of America's Oil Shale Resource", while oil shale is located in many countries throughout the world, the Green River Basin of northwestern Colorado, eastern Utah, and southwestern Wyoming contains the largest, most concentrated quantities of potentially recoverable shale oil in the world. The Report indicates that the Basin may have as much as 1.6 trillion barrels of oil in place, of which an estimated 1 trillion barrels ultimately may be recoverable using various recovery technologies. This latter number is roughly equivalent to all the combined proven conventional oil reserves in the world today, (see DOE Charts 3, 4 & 5).
Given the size of the resource, Shell is committed to pursuing commercially and environmentally viable technologies that can unlock the enormous potential for oil shale that exists in the Rockies. Shell's advancing ICP research is getting us close to being able to help unlock these resources. We believe that successful utilization of the ICP technology could yield substantial economic impacts to Colorado, the rest of the Rocky Mountain West and to the United States as a whole.
Clearly, Shell believes there is a role for the appropriate development of oil shale deposits as part of America's overall energy

and conservation mix to meet increasing energy demand. We are committed to the principles of Sustainable Development, to ensuring that our activities minimize the impact on the environment, and to enhancing opportunities for local communities while facilitating our business objectives.

Ironically, despite the fact that that the United States clearly has the largest and most concentrated oil shale resources in the world, several other countries have ongoing oil shale Research and Development projects. Australia, China, Estonia and Brazil are all progressing projects that are governmentally assisted or driven in one fashion or another. It is Shell's belief that the time has come for the United States to join these other nations so as to encourage, facilitate, and accelerate the development of this potentially vast domestic energy resource.

A range of options should be seriously considered in order to accelerate responsible U.S. oil shale development that would enhance national security and protect our Nation's economy. We would offer the following six recommendations for Congressional consideration. While we are not including specific legislative language, we are eager to work with the House Resources Committee and this Subcommittee, as well as all other relevant House and Senate Committees of jurisdiction on specific language to create the proper mix of incentives and opportunities for accelerated, but responsible, oil shale development.

Recommendations for Congressional consideration of six important provisions:

1. Shell believes that the U.S. government should recognize oil shale as a strategically important domestic energy source. We believe that Congress and the Administration should officially support public policy initiatives that encourage and support accelerated commercial oil shale development and use as a feedstock for transportation fuels and other products.

2. Shell believes that the Secretary of the Interior should develop a commercial oil shale leasing program on an expedited basis. We support the BLM's recently announced R&D oil shale leasing program as an important first step in the right direction. BLM should now be urged to implement that program on an expedited basis.

Shell thanks the House Resources Committee and this important subcommittee for providing important leadership to the full House of Representatives for including language in the recently passed House Energy Bill that in general terms would adopt these first two recommendations. We hope that legislative opportunities will arise in the future to give favorable consideration to passage of language to address the next four topics.

3. Congress should act to lift the current federal acreage limitation under Title 30, Section 241(a) of the Mineral Lands Leasing Act that restricts a lessee to acquisition of but one lease of 5,120 acres nationally. In order to facilitate commercial development for oil shale production, Shell believes that this acreage limitation should be removed. Otherwise, companies that wish to build facilities and produce shale oil from federal lands will forever be limited to one project. Such a limitation, which dates back to 1920, until changed will create an impediment to even first-generation projects where the costs and risks will be greatest.

4. Congress and the Administration should work to develop royalty rates that encourage investment in oil shale development, giving particular recognition to the extraordinary costs involved in literally bringing a new energy industry into existence. In particular, Shell believes that government should develop a royalty regime for first generation commercial oil shale production that: 1) is simple to administer and to enforce and eliminates the need for interpretation or the likelihood of litigation; 2) would deliver significant revenue to the U.S. Government, and thus 50% of that amount to the impacted states; and 3) would not involve royalty rates that so steep as to create another obstacle to the acceleration of large-scale first generation commercial oil shale projects.

5. Shell believes that Congress and the Administration should work to ensure that an appropriate system is put in place to provide certainty and timeliness in the permitting process for oil shale development without waiving substantive environmental performance standards. A concern is that sequential overlay of multiple federal and state permitting processes has the potential to add many years to what will already be a complex and protracted permitting process.

6. Congress and the Administration should identify appropriate tax incentives that encourage investment in oil shale technology and development, that recognize the research and development hurdles involved in oil shale technology and development, and that appropriately treat oil shale production as the development of a "non-conventional resource" in a manner similar to other non-conventional energy resources. Specifically, where ambiguities may now exist relative to determining whether or not in-situ oil shale recovery technologies will qualify for tax benefits in the same manner as do existing mining tax regimes, those ambiguities should be cleared up as soon as practicable.

In summary, the United States has a huge domestic energy resource in the form of oil shale. The time has come for Congress and this Administration to consider appropriately targeted legislative and regulatory measures to allow oil shale to be developed at an early date, provided that such development can occur in an economically feasible and environmentally acceptable manner. Shell is increasingly encouraged and optimistic that our ICP technology may very well represent the first available technology to do so.

This completes my written testimony. I will be happy to respond orally or in writing to any questions any Committee member may have.