America’s Energy Resource:
Western U.S. Oil Shale

- Oil shale is a fine-grained sedimentary rock containing a solid material (kerogen) that converts to liquid oil when heated. Oil shale deposits exist in 37 countries globally, but the largest and highest quality oil shale deposits are in sparsely populated areas of Colorado, Utah and Wyoming (Figure 1).

- Historically, oil shale has proven to be technically, environmentally and economically challenging to develop. However, through ongoing research efforts, new and innovative production technologies are emerging.

- The potentially recoverable oil from Western U.S. oil shale deposits is estimated at more than 800 billion barrels, or nearly three times the proven oil reserves of Saudi Arabia (Figure 2).²

- This significant domestic resource has the potential to reduce foreign oil imports, increase and diversify U.S. transportation fuel supplies, create thousands of American jobs, and fuel U.S. economic growth.

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1 Bartis et al. 2005 “Oil Shale Development in the United States, Prospects and Policy Issues,” prepared for the National Energy Technology Laboratory of the U.S. Department of Energy

2 DOE Energy Information Administration - Country Analysis Briefs
America’s Energy Security: Growing Demand, Increasing Competition for Limited Supplies

- Global demand for petroleum and other liquid fuels is projected to rise from an estimated 86 million barrels per day in 2010 to over 112 million barrels per day by 2035.³
- Demand growth is being driven by increasing consumption in rapidly developing countries such as China and India. These emerging economic giants are expected to continue to experience a significant increase in Gross Domestic Product and individual automobile ownership.
- In 2010, U.S. net imports comprised approximately half of our petroleum liquid fuel supply.⁵
- America’s national security is dependent on the availability of liquid fuels. For example, the U.S. Department of Defense is the single largest consumer of energy in the country, consuming more than 5 billion gallons of fuel in 2010 for military operations.⁶

![Figure 3. U.S. oil production and imports.](image)

Since the early-1990s, there has been a consistent gap between U.S. crude oil field production and crude oil/petroleum imports.⁴

America’s Energy Choice: Increase Our Domestic Oil Supply

- Crude oil price volatility and energy market instability significantly impact our entire economy.
- In April 2011, oil reached over $113 per barrel — then plunged nearly 32% by October, before rising more than 30% over the next four months.⁷
- The need to meet U.S. transportation fuel demand with a stable, secure and affordable source of domestic supply has never been greater. U.S. oil shale development can help to reduce our dependence on foreign oil, increase our domestic energy security and significantly stabilize increasingly volatile global energy markets.
- Currently, more than 70% of western U.S. oil shale deposits are on federal lands. Most federal oil shale is closed to development despite the growing need for new sources of oil supply.⁸
- With access to these lands, advancements in technology and thoughtful planning, U.S. oil shale resources can be developed in an environmentally responsible and economically sustainable manner.

⁷ NYMEX crude oil price records
Introduction

- The API U.S. Oil Shale Subcommittee is committed to environmentally responsible oil shale development. Participating companies have made technological advancements that substantially mitigate environmental impacts associated with oil shale production and are committed to continued research and development in this area.
- Reducing energy usage and carbon emissions, protecting ground and surface water resources, reducing surface disturbance, and protecting wildlife resources are key focus areas, with significant capital and resources being spent on each of these issues at no cost to the taxpayer.
- The U.S. Department of the Interior’s Research, Development and Demonstration program provides an opportunity to consider all development effects, improve mitigation technologies and advance commercial-scale development again at no cost to the taxpayer.
- Additionally, all federal oil shale research and development projects are subject to the National Environmental Policy Act (NEPA), the Clean Air and Clean Water Acts, and the Endangered Species Act.

Protecting and Conserving Our Water

How will ground and surface water systems be protected?

- Technologies and best management practices (BMPs) to protect ground water during oil shale development have been commercially demonstrated in mining and chemical processing operations. For example, freeze wall technologies can be deployed to isolate ground water from subsurface (in-situ) oil shale production (Figure 1).
- Alternative approaches target oil shale development well below existing aquifers, naturally isolating produced oil shale zones from ground and surface water systems.
- Federal laws and regulations with stringent environmental standards are currently in place to ensure that ground and surface water systems are protected before development operations can commence.
- Reclamation and remediation plans will also be required to ensure long-term protection after operations cease.

Figure 1. Freeze wall schematic.

The recently completed Freeze Wall Test, located on Shell’s private property in Rio Blanco County, Colorado, was a major, multi-year test of a commercial freeze wall prototype. The project successfully demonstrated that groundwater can be kept out of subsurface production areas using a frozen, underground barrier.

Courtesy of Shell Oil

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How much water will be needed for development? Is there enough?

- As with all commercial activities, water will be required to meet a variety of needs during oil shale development. Water needs will vary for different production technologies.
- Based on experience from current oil shale pilot projects and ongoing development of modern oil shale technologies, water use is estimated at one to three barrels of water per barrel of oil produced.
- A 500,000-barrel-of-oil-per-day U.S. oil shale industry would require less than 50,000 acre-feet of water annually, which is well below water availability estimates in the development area. Put another way, it would take less than 1% of the water each year from the Colorado River Basin to produce 10% of our country’s liquid fuels needs.
- As technology and industry research efforts mature, water needs will likely decrease due to increases in efficiency.

Where will the water come from?

- While enough fresh water is available from the Colorado River Basin alone, potential oil shale developers are committed to minimizing the burden on this precious resource.
- One alternative source of process water may be non-potable water produced from existing oil and gas wells in the area. If this water was treated and diverted to meet water requirements for a 500,000 barrel-per-day U.S. oil shale industry, demand on fresh water resources would be significantly reduced with current technologies.

- Another source for water is the oil shale itself. Western oil shale has high water content, with 0.25 barrels of water produced per barrel of oil. Much of this water can be recovered during development and recycled.
- To further quantify water needs and explore recycling options, site-specific access to the Western oil shale resources on federal lands and a path forward on a commercial program is needed.
- The oil shale industry recognizes the premium that is placed on water in the Western U.S. and shares the important goal of water stewardship.

2 Red Leaf Resources — EcoShale Pilot Project
Protecting Our Land

- Land surface impacts of oil shale development will depend on the technology used to produce the resource.
- For subsurface (in situ) developments, land surface impacts can be mitigated by a “rolling development” process by which some are under development while others are being reclaimed.
- Alternatively, in many areas where oil shale deposits are nearer to the surface, underground mining technologies may be used in lieu of open-pit mining.
- Regardless of the technology used to develop the oil shale, stringent requirements are in place to reclaim affected surface lands post-development.

Protecting Our Wildlife

- Oil and gas operations in Western oil shale areas have co-existed with wildlife resources for many years.
- In coordination with state wildlife agencies, undesirable impacts on indigenous and migratory wildlife have been effectively mitigated by careful planning (e.g., timing of operations relative to known wildlife activities in the area, and required offsets from conservation and wilderness areas).

Protecting Our Air Quality

- Commercially available stack gas clean-up technologies for controlling oxides and particulate emissions have improved significantly in recent years and will be effective in protecting the air quality in the region.
- Future developments will also use effective, best management practices for dust control.
- Technologies are also available for capturing, concentrating, storing or utilizing CO₂ generated in oil and gas production processes:
  - Carbon dioxide may be sequestered in deep saltwater-bearing formations, produced oil or gas reservoirs, or deep coal seams and shales.
  - The 2012 North American Carbon Storage Atlas estimates that at least 1,791 billion metric tons (1,974 billion tons)—and up to 20,394 billion metric tons (22,480 billion tons)—of CO₂ may be sequestered in such repositories in the U.S.³

Introduction

- Development of U.S. oil shale resources will generate significant employment opportunities and substantial government revenues.

- Oil shale production could help reduce the trade deficit and enhance domestic energy security through increased domestic energy production.

- As the global economy and global demand for liquid fuels have returned to growth, there has been corresponding upward pressure on the costs of petroleum-based transportation fuels. A U.S. oil shale industry can help to mitigate such price increases.

- With more than 70% of the Western U.S. resource on public lands, oil shale development can provide a significant and consistent federal revenue stream for decades.

Our Economy: Increased Tax Revenues and Reduced Deficits

How can oil shale development increase tax revenues?

- A robust U.S. oil shale industry can yield significant economic benefits to our country in the form of taxes and royalty payments. The U.S. Strategic Unconventional Fuels Task Force estimated that the initial 25-year period of oil shale production could yield cumulative public sector revenues in excess of $400 billion.

How can oil shale production help reduce the trade deficit?

- In 2011, total U.S. petroleum consumption was 18.9 million barrels per day, while total U.S. petroleum production was about 10.1 million barrels per day.

- In 2011, the price tag on petroleum-related products from foreign suppliers was about $440 billion, or 78% of the U.S. goods and services trade deficit of nearly $560 billion.

Figure 1. Cost of U.S. Imports of Energy-Related Petroleum Products

- Access to and development of oil shale resources on U.S. federal lands can help to materially reduce the trade deficit.

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Our Jobs: Quality Jobs and Quality Plans

How can desirable social and economic impacts be achieved for local communities?

- Comprehensive front-end planning, public education and effective communication with local stakeholders, including identifying various solutions for meeting local infrastructure needs.
- Engaging and informing the public about the potential timing, the length of development projects, and all potential impacts.
- Oil shale developers are committed to engaging with local communities to address and effectively prepare for these challenges in advance of commercial development.

- A new U.S. oil shale industry could create up to 100,000 new jobs and contribute $1.9 trillion to the U.S. GDP.  

- While these benefits are clear, it is important to recognize and appropriately plan for the activity that can accompany such growth.

What are some of the potential impacts on the community?

- In addition to significant revenues being generated by development for local communities, greater demand for services associated with increased economic activity may require additional budget outlays.
- Home valuations and housing demand and market conditions are likely to improve with the establishment of a growing and well-paid local workforce.
- Service industry jobs are likely to be in great demand as primary employee needs increase.
- Local growth may lead to the need to enhance general public services, such as fire and police protection, education and utility services.

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