U.S. OIL SHALE:
PROTECTING OUR ENVIRONMENT

Introduction

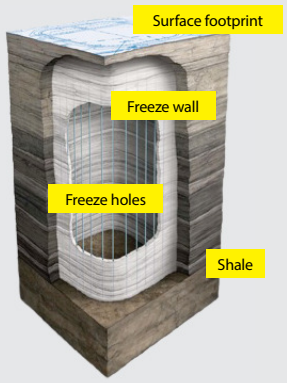
- The API U.S. Oil Shale Subcommittee is committed to environmentally responsible oil shale development. Participating companies have made technological advancements that substantially mitigate environmental impacts associated with oil shale production and are committed to continued research and development 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

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.[1] 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.[2] 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.

1 URS Corporation, 2008, "Energy Development Water Needs Assessment (Phase I Report)," 144 pp.
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 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 CO_2 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 CO_2 may be sequestered in such repositories in the U.S.[3]

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).

3 The North American Carbon Storage Atlas 2012, at http://www.netl.doe.gov/technologies/carbon_seq/refshelf/NACSA2012.pdf