



### **What is Underground Coal Gasification?**

Underground Coal Gasification (UCG) is a technology that harnesses the energy potential of coal in the ground without mining. The gasification process takes place deep underground within the coal seam. Air is injected into the coal through one well. The coal is then synthesized into a product called syngas, also known as synthesis gas, and produced from a second well. UCG uses reactions between the coal, oxygen from the injected air and water that is in the coal seam to produce hydrogen, carbon monoxide and methane. The syngas can be handled and used much like natural gas. It can, for example, be piped, stored and used to fuel a turbine to generate electricity. Syngas can also be upgraded with methanation into synthetic natural gas.

The gasification process occurs underground (“in-situ”), foregoing most of the dangerous, dirty and destructive effects of coal mining. UCG requires minimal infrastructure and involves very little physical disruption to the natural area above the coal seam. There are wells, pipelines, compressors and some gas processing equipment at the production site.

UCG represents a dramatic shift in the method of accessing and unlocking the energy potential of an abundant domestic natural resource. When combined with carbon capture and sequestration, the UCG process of producing, transporting and using coal energy leaves about the same carbon footprint as traditional natural gas.

### **UCG: How it works**

Responsible UCG projects require careful site selection and evaluation to identify deep coal seams that are typically at least 650 feet below the surface, below the water table and contained by strong, impermeable layers of rock.

After appropriate site selection and evaluation, the process typically begins by drilling two well holes into the coal seam a few hundred feet apart. Operators inject air (for the oxygen) into one of the wells and then start a carefully-controlled combustion reaction. The heat and pressure created by the reaction converts the coal into syngas. The gas moves through a permeable path that has been created in the coal where the second well vents it to the surface. Only syngas is removed, leaving ash and most other byproducts deep underground. Following some surface processing, the gas is ready for near-site use or transport. The operation can be expanded by drilling additional process wells. Some of the coal is left in place to prevent subsidence (unintentional settling).

The UCG process is controlled from the surface by managing the injection of the oxygen. Operators can quickly halt the process at any time by cutting the oxygen supply or flooding the well with water. Natural water influx will quench the reactions, eliminating any potential for unwanted coal-seam fires.

### **Why consider UCG?**

Commercial-scale UCG projects have been used to gasify coal for more than 50 years. There have been more than 50 test and commercial UCG projects worldwide, including in the United States. Numerous commercial operations are currently in various stages of design, development, scale-up or operation. Recent investment and scientific study have led to a better scientific understanding of the UCG process.

Commercial-scale carbon capture technologies are mature and have been successfully used for years to remove carbon dioxide from syngas produced at surface coal-gasification plants. UCG lends itself easily to carbon capture and sequestration. The UCG process

also produces syngas at temperatures, pressures and CO<sub>2</sub> concentrations that enable relatively simple, low-cost carbon removal, prior to use. The syngas is then burned to create clean energy with a carbon emission footprint similar to that of natural gas and far below that of coal mining and combustion.

UCG with CCS eliminates most of the environmental and safety issues associated with coal mining and energy generation, including mine safety, surface disfiguration, coal dust, surface water contamination and other pollutants including carbon dioxide, nitrogen oxide, sulfur dioxide, ash, mercury, arsenic, sulfur and tar. UCG's biggest environmental concerns involve subsidence and underground residues that can be managed with careful project site selection and evaluation, design and operation.

UCG with carbon capture is clean, economical and safe. It has a small carbon and environmental footprint. UCG with CCS can become a bridge technology that will help our nation move toward domestically produced, sustainable energy resources and away from its dependence on imported oil.

### **Key Facts**

- UCG harnesses the energy potential of coal underneath the ground—without conventional mining
- UCG produces syngas, which can be burned directly for heat or electricity, or converted to other products such as synthetic natural gas, hydrogen, methanol or hydrocarbon liquids
- UCG works well in conjunction with carbon capture and sequestration (CCS)
- UCG with CCS can provide clean, reliable and competitively-priced power to meet today's energy needs
- UCG uses coal that is otherwise not economically recoverable
- UCG is a safe technology that has been used commercially for more than 50 years
- Careful site selection and process operation assure minimal environmental impacts
- UCG with carbon capture is a bridge technology that can help Alaska and the United States move toward energy independence