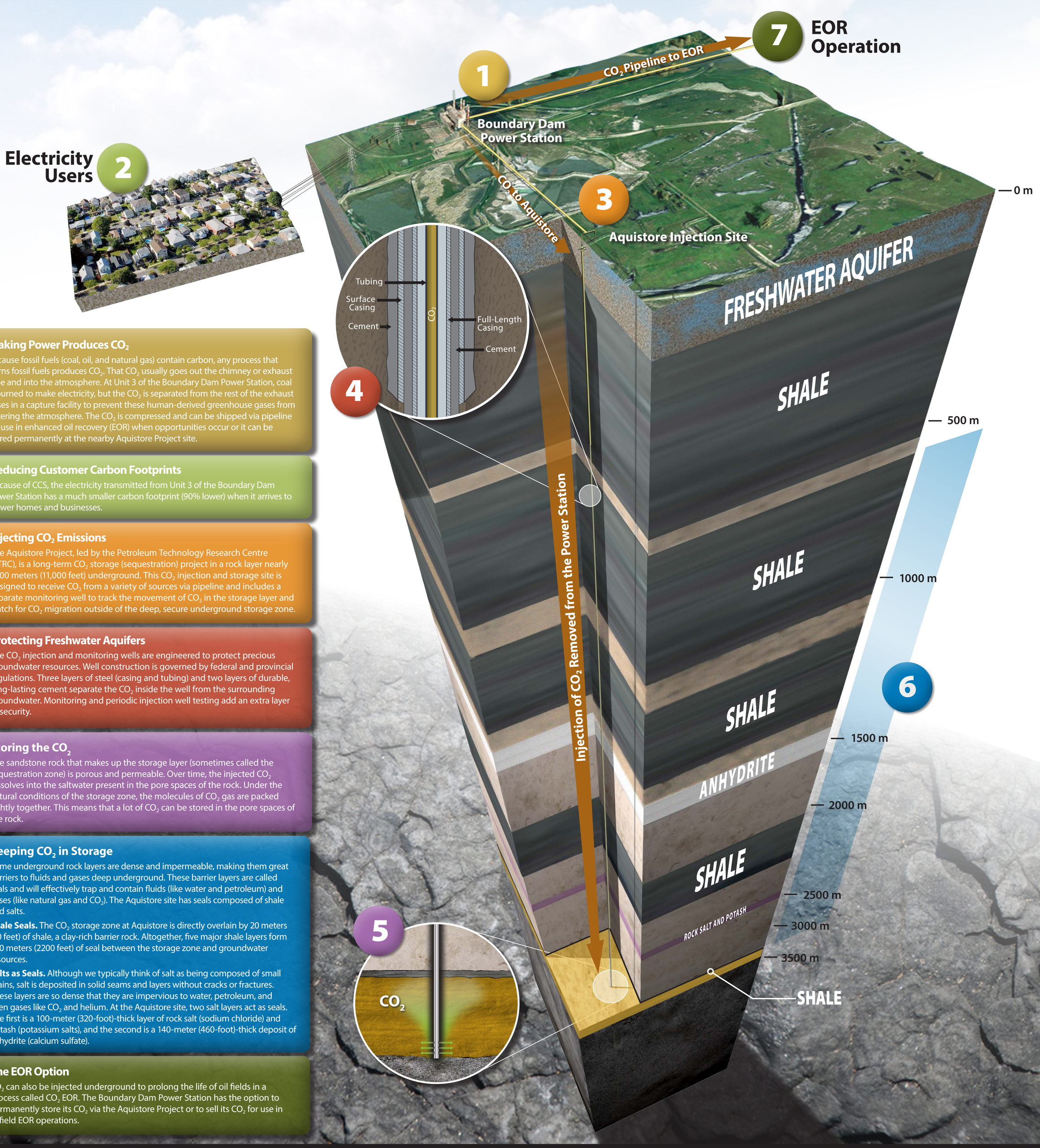
Aquistore: Demonstrating Carbon Storage

The Aquistore Story

The Aquistore Project adjacent to the Boundary Dam Power Station west of Estevan, Saskatchewan, is an innovative greenhouse gas storage effort to address concerns about climate change:

- Carbon dioxide (CO_2) is produced by the six units at the Boundary Dam Power Station when coal is burned to make electricity.
- The CO_2 from Unit 3 is captured instead of being released into the atmosphere.
- The CO_2 separated from the exhaust gases at Unit 3 travels through a 3-kilometer (2-mile) pipeline to the Aquistore site, where it is injected into a deep sandstone rock formation.
- The injected CO_2 will remain trapped (sequestered) in the underground zone for millions of years.
- The injected CO_2 will be monitored to ensure that it remains securely stored.

This entire process is called carbon capture and storage, or CCS.



1 Making Power Produces CO_2

Because fossil fuels (coal, oil, and natural gas) contain carbon, any process that burns fossil fuels produces CO_2. That CO_2 usually goes out the chimney or exhaust pipe and into the atmosphere. At Unit 3 of the Boundary Dam Power Station, coal is burned to make electricity, but the CO_2 is separated from the rest of the exhaust gases in a capture facility to prevent these human-derived greenhouse gases from entering the atmosphere. The CO_2 is compressed and can be shipped via pipeline for use in enhanced oil recovery (EOR) when opportunities occur or it can be stored permanently at the nearby Aquistore Project site.

2 Reducing Customer Carbon Footprints

Because of CCS, the electricity transmitted from Unit 3 of the Boundary Dam Power Station has a much smaller carbon footprint (90% lower) when it arrives to power homes and businesses.

3 Injecting CO_2 Emissions

The Aquistore Project, led by the Petroleum Technology Research Centre (PTRC), is a long-term CO_2 storage (sequestration) project in a rock layer nearly 3400 meters (11,000 feet) underground. This CO_2 injection and storage site is designed to receive CO_2 from a variety of sources via pipeline and includes a separate monitoring well to track the movement of CO_2 in the storage layer and watch for CO_2 migration outside of the deep, secure underground storage zone.

4 Protecting Freshwater Aquifers

The CO_2 injection and monitoring wells are engineered to protect precious groundwater resources. Well construction is governed by federal and provincial regulations. Three layers of steel (casing and tubing) and two layers of durable, long-lasting cement separate the CO_2 inside the well from the surrounding groundwater. Monitoring and periodic injection well testing add an extra layer of security.

5 Storing the CO_2

The sandstone rock that makes up the storage layer (sometimes called the sequestration zone) is porous and permeable. Over time, the injected CO_2 dissolves into the saltwater present in the pore spaces of the rock. Under the natural conditions of the storage zone, the molecules of CO_2 gas are packed tightly together. This means that a lot of CO_2 can be stored in the pore spaces of the rock.

6 Keeping CO_2 in Storage

Some underground rock layers are dense and impermeable, making them great barriers to fluids and gases deep underground. These barrier layers are called seals and will effectively trap and contain fluids (like water and petroleum) and gases (like natural gas and CO_2). The Aquistore site has seals composed of shale and salts.

Shale Seals. The CO_2 storage zone at Aquistore is directly overlain by 20 meters (60 feet) of shale, a clay-rich barrier rock. Altogether, five major shale layers form 680 meters (2200 feet) of seal between the storage zone and groundwater resources.

Salts as Seals. Although we typically think of salt as being composed of small grains, salt is deposited in solid seams and layers without cracks or fractures. These layers are so dense that they are impervious to water, petroleum, and even gases like CO_2 and helium. At the Aquistore site, two salt layers act as seals. The first is a 100-meter (320-foot)-thick layer of rock salt (sodium chloride) and potash (potassium salts), and the second is a 140-meter (460-foot)-thick deposit of anhydrite (calcium sulfate).

7 The EOR Option

CO_2 can also be injected underground to prolong the life of oil fields in a process called CO_2 EOR. The Boundary Dam Power Station has the option to permanently store its CO_2 via the Aquistore Project or to sell its CO_2 for use in oilfield EOR operations.

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Aquistore

This poster was produced by the Plains CO_2 Reduction (PCOR) Partnership, led by the University of North Dakota's Energy & Environmental Research Center, in cooperation with PTRC. The PCOR Partnership represents a wide variety of public and private sector stakeholders located across nine states and four Canadian provinces in the heartland of North America. It is one of seven regional partnerships that make up the Regional Carbon Sequestration Partnership Program, managed within the U.S. Department of Energy's Office of Fossil Energy by the National Energy Technology Laboratory (NETL). Funding is provided by NETL and the members of the PCOR Partnership. To learn more about the options to manage carbon emissions from energy use, including PTRC's Aquistore Project, visit the PCOR Partnership Web site at www.undeerc.org/PCOR.