The fuel cell power module produces electricity that is either stored in the batteries, or directly fed to the chopper board.

3. The electricity from the batteries or fuel cell is throttled by the chopper board in the electrical cabinet.

4. The throttled electricity is delivered to the traction motors.

How do fuel cells power a locomotive?

This diagram shows how fuel cells can power a locomotive using a hybrid battery storage system. Each step of the process is shown:

1. Hydrogen is used by an onboard fuel cell power module.
2. The fuel cell power module produces electricity that is either stored in the batteries, or directly fed to the chopper board.
3. The electricity from the batteries or fuel cell is throttled by the chopper board in the electrical cabinet.
4. The throttled electricity is delivered to the traction motors.

BNSF experiments with fuel cells

BNSF Railway is developing an experimental hydrogen fuel cell powered switching locomotive. Working with Vehicle Projects LLC, a private engineering firm headquartered in Denver, the railway’s mechanical department is associated with the locomotive (which started as an EMD GP9 and was later rebuilt into a Type Power-Green Goat) in BNSF’s Topuka, Kan. shop. The two say the fuel cell locomotive has the potential to reduce air pollution as well as prepare for locomotives that are not dependent on expensive oil for fuel.

Throughout its system, BNSF locomotives currently burn more than 4 million gallons of diesel fuel a day, about 2 percent of U.S. diesel fuel usage. The railroad in its third-quarter 2007 filings said diesel fuel costs represent 26 percent of its operating costs. Using fuel cells in vehicles such as buses and automobiles is not new, but its introduction into railroading by a Class I is so how does this technology work and is it really an innovative path to new methods of powering trains?

A fuel cell is an electrochemical device that combines hydrogen and oxygen to produce electricity, with water and heat as a byproduct. As long as fuel (hydrogen and oxygen) is available, the fuel cell continues to generate power.

BNSF says the oxygen used by a fuel cell comes from the air, while the hydrogen must be provided. Electricity produced by the fuel cell to generate hydrogen can come from any number of available sources including nuclear, wind, and solar.

The experimental locomotive will carry compressed hydrogen on board in tanks similar to those used on fuel-cell-powered highway vehicles. Since fuel cells convert fuel to energy via an electrochemical process rather than combustion, the process is clean (meaning no emissions), quiet, and highly efficient.

How efficient? BNSF engineers say it can be up to two to three times more efficient than the standard diesel locomotive, although that calculation does not take into account the energy required to produce the hydrogen the fuel cells use.

For something like a locomotive, fuel cell technology might provide much higher starting torque and overload capacity than the technology might provide much higher starting torque and overload capacity than the diesel engine could.

The Class I’s current experimental locomotive should be viewed as concept vehicle to demonstrate that it is possible to adapt hydrogen fuel cell technology to a rail application, a BNSF spokesman says. Whether the technology will be commercially viable depends on a number of factors, including the need for production, storage, and distribution of hydrogen. That infrastructure does not currently exist, he says, and would require a substantial investment.

Will this technology ever be adopted across the rail industry? Time will tell. But in an era of increasing oil supply, this hydrogen-powered hybrid could be the dawn of a new age in rail transportation.