



CPKC and hydrogen freight locomotion

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How can a railroad eliminate its carbon emissions while still meeting its commitments to its customers and the larger economy?

That's the question CPKC sought to answer with the Hydrogen Locomotive Program.

Railroads start from a place of strength environmentally. Here in Canada, for example, we move 70 percent of the nation's intercity freight while generating 3.5 percent of the transportation industry's greenhouse gas emissions. Still, the operation of a diesel locomotive fleet represents the company's largest source of carbon emissions and our greatest opportunity to address climate impacts from our operation.

The transition to a low-carbon economy presents challenges and opportunities for the transportation sector. To align CPKC and our stakeholders as we navigate this dynamic change, we published CPKC's first Climate Strategy in 2021, charting our approach to managing potential climate-related impacts across the business while capitalizing on low-carbon opportunities.

Real-world conditions

Hydrogen fuel cells use a chemical reaction that converts hydrogen to water and releases electricity. The only emission from the process is water vapour. The technology has been tried and proven. However, its use in rail applications has been limited. In Europe, rail operators have tested fuel cells in passenger applications, where loads are light. In the U.S., one test explored the use of fuel cells in a light-duty locomotive assigned to a freight yard, where operations are typically under 10 mph and only small numbers of railcars are handled at a time.

With CPKC's Hydrogen Locomotive Program, by contrast, we're developing line-haul locomotives capable of operating at speeds and generating horsepower comparable to a road-service diesel locomotive. We anticipate these locomotives will be able to haul full-length freight trains over main lines at track speed.

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We started with plans for one medium-duty unit in December 2020, which is now built and is starting testing trials. In November 2021, with funding from Emissions Reduction Alberta matching CPKC's commitment, we announced two additional units: one high horsepower and one light-duty. Each of the three represents a class of locomotive currently in service in the North American fleet and will be tested under the operating conditions ordinarily faced by that class of locomotive.

The next generation of locomotion

CPKC's existing locomotive fleet uses a diesel-electric drivetrain, meaning powerful diesel engines turn a generator, making electricity to power traction motors that turn the locomotive's axles. It's a reliable system of locomotion that has dominated the industry since the middle of the last century. But because it relies on the consumption of fossil fuels, it emits carbon.

Sustainably Driven

CPKC



A hydrogen locomotive generates electricity using its fuel cell. It also generates electricity using regenerative braking, in which it absorbs the train's downhill momentum, powering a generator while it keeps train speed under control. Electricity from these two sources charges banks of batteries carried onboard the locomotive. The batteries then feed electricity to the locomotive's traction motors.



Generating hydrogen fuel

Hydrogen is the most abundant element in the universe, but creating hydrogen fuel means separating hydrogen from the other elements with which it likes to bond. That takes energy. So making hydrogen locomotion zero-carbon means considering how we generate hydrogen fuel.

CPKC is working with ATCO to construct two hydrogen generation and fueling facilities in support of the Hydrogen Locomotive Program. Both hydrogen production and fuelling facilities will deploy electrolyzer technology to produce hydrogen fuel from water. One of these plants will be located at CPKC's Calgary headquarters and will operate on renewable electricity from a 5-megawatt solar farm project, which became operational in 2021. This hydrogen production plant will operate on renewable power to produce hydrogen fuel to power CPKC's hydrogen locomotive without emitting greenhouse gases.

Next steps

We now need to prove that hydrogen locomotion in heavy-haul freight applications works in the real world. That means putting our hydrogen locomotives at the front of trains loaded with freight and analyzing how they perform. Alberta is the ideal location. The province has shown its support for the program through its grant. Additionally, Alberta possesses many of the different conditions a locomotive can encounter: hot and cold temperatures, flat and mountainous terrain, freight yard applications and main line operations.

CPKC is a sustainably driven company. Our customers, employees and shareholders are invested in a more sustainable future. If we're successful here, hydrogen locomotives could one day provide zero-emissions locomotion far beyond the boundaries of Alberta, or of CPKC's network.

We remain committed to long-term sustainable growth, planning for the future and confronting the challenges created by climate change. Climate leadership within the rail industry will require a diverse range of actions and expertise, from alternative fuels and emerging technologies to customer engagement, business integration and improved resilience of our physical assets. Transportation of freight by rail will play an integral role in the low-carbon future for North America, and we are proud to take a leadership role in this transformation.



For more information on sustainability at CPKC or our hydrogen locomotive program visit cpkcr.com