HYDROGEN LOCOMOTIVE PROGRAM

FRA Decarbonization Workshop

May 17, 2023

Matthew Findlay

WHO WE ARE

CONNECTING CANADA, the U.S. AND MEXICO, *TOGETHER*

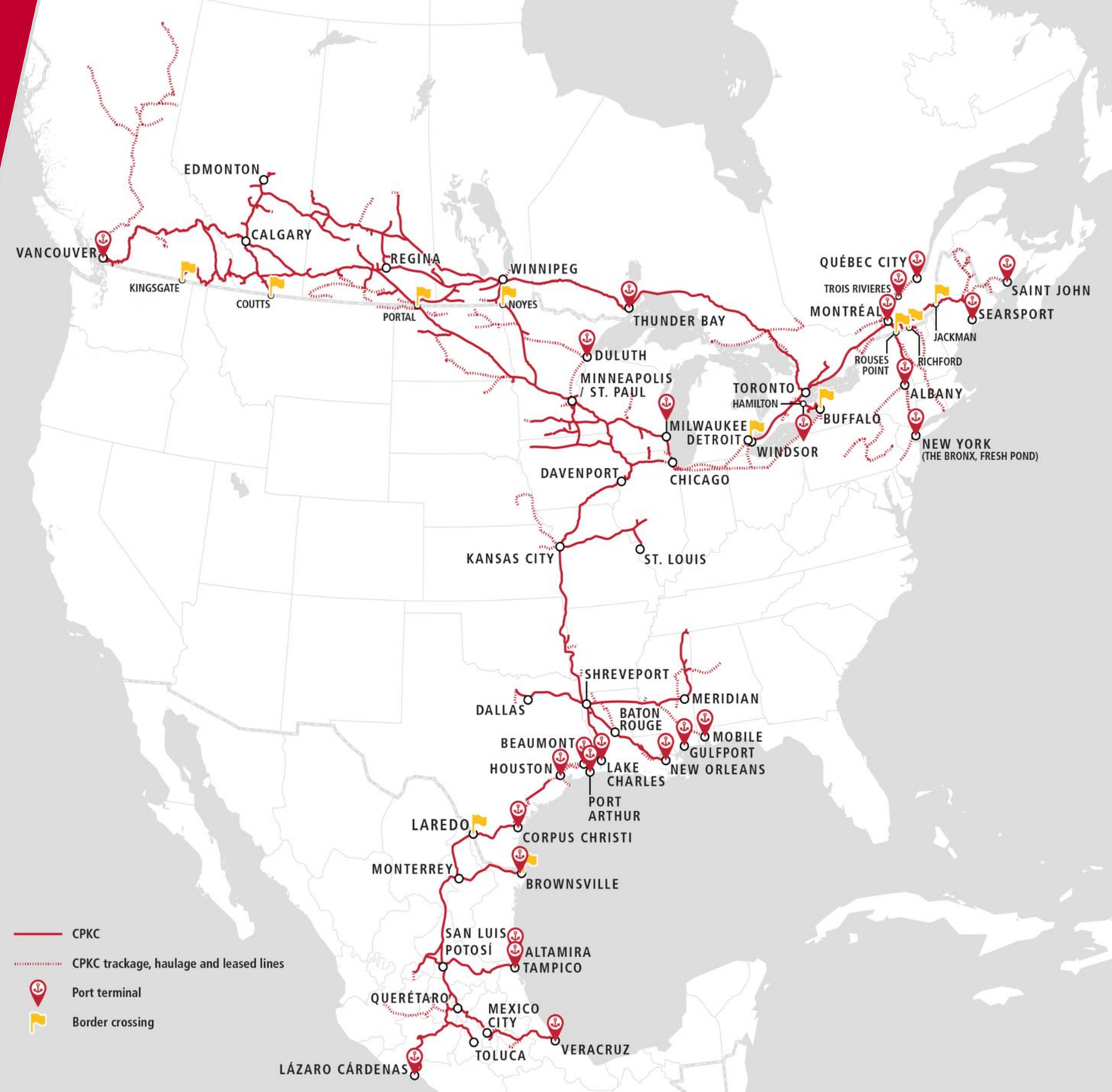
FIRST
TRANSNATIONAL
SINGLE-LINE RAILWAY

20,000
MILE
RAIL NETWORK

NEARLY
20,000
EMPLOYEES

WE GO WHERE OTHERS CAN'T

Transforming the future of freight rail by creating the **safest**, most **reliable** and **relevant** railroad in North America, serving as the backbone for commerce and economic growth.



SUSTAINABLY DRIVEN

Hydrogen-Powered Locomotive Project

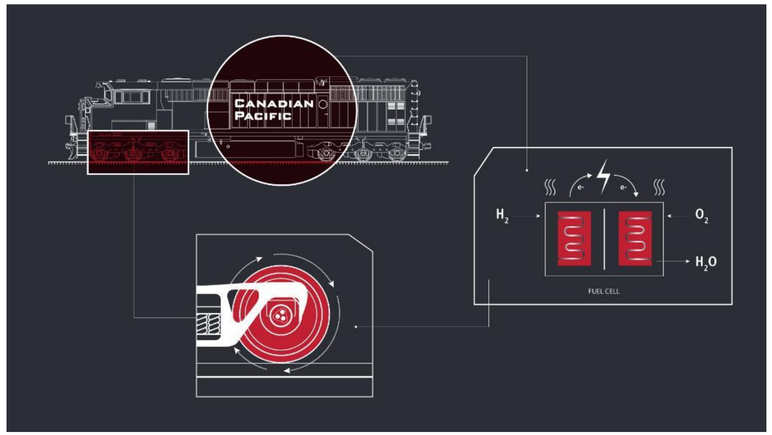
CPKC's Hydrogen Locomotive Program aims to develop North America's first line-haul hydrogen-powered freight locomotive.

CPKC has initiated a program to convert three different types of diesel-electric locomotives into zero-emissions hydrogen-powered locomotives using fuel cells and batteries to power electric traction motors. The program has the potential to significantly reduce greenhouse gas emissions from locomotive operations, supporting CPKC's Climate Change Commitments and the transition to a low-carbon future in the freight rail sector.

HYDROGEN CONCEPTS

Why Our Hybrid Design?

- Zero emissions
- Similar refueling times to diesel possible + DTL fueling
- Locomotive can operate independently and recharge its own batteries – no wayside charger, genset or diesel-electric consist or fixed recharge location required
- Hydrogen energy density higher than batteries
- Batteries can recapture energy from dynamic braking – saving hydrogen and extending range



- Available from Tier 1 passenger suppliers
- Hydrogen fuel cells and batteries
- Duty cycle different from freight service
- Commercialization in process – Europe, Asia and North America

- Both Tier 1 locomotive suppliers are working on 100% BEL
- Wabtec 2.4 MWh road demonstrator up to 7 MWh
- Progress Rail – Up to 14.5 MWh in various applications

CPKC HYDROGEN LOCOMOTIVE PROGRAM

Locomotive Fueling Options

On-Site Delivery

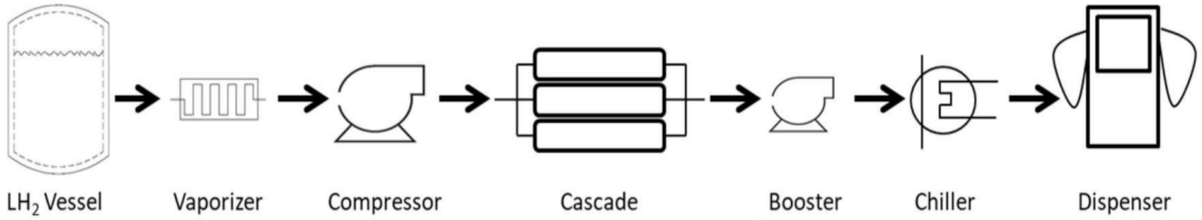
- Delivered from trailer direct to locomotive
- On-Site Liquid or Gaseous storage and dispensing

On-Site Storage/Production

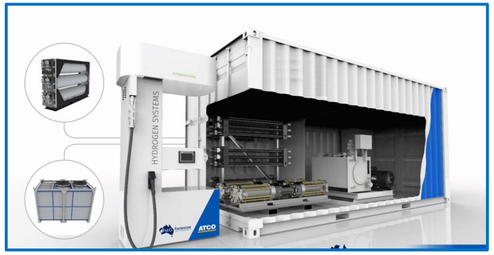
- Electrolyzer or Steam-Methane Reformer
- Continuous supply from Solar Power, Natural Gas, or Electrical Grid

Options provide flexibility to fuel the locomotive without requiring fixed point charging locations essentially enabling the same operating conditions we have today

Direct to Locomotive from H_2 Trailer



Liquified or Gaseous H_2 storage to dispensing



Green H_2 from on-site Solar capability and an Electrolyzer

CPKC HYDROGEN LOCOMOTIVE PROGRAM

From Concept to Reality

Q2 2020 – Investor Inquiries – Zero Carbon Projects

Q3 2020 – Railway Technology - Project Ideas and Exploration

Q4 2020 – Hydrogen Locomotive – Project Start – CP 1001

Q2 2021 – Hydrogen Locomotive – Program Expansion

Q4 2021 – Hydrogen Locomotive – First Movement

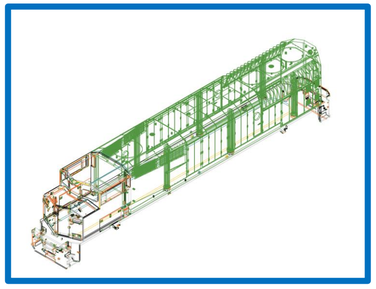
Q2 2022 – Hydrogen Locomotive – Terminal Switching Testing

Q4 2022 – Hydrogen Locomotive – Mainline Testing & Transport Canada Approval

Q4 2022 – Hydrogen Locomotive – CP 1002 Fabrication Completed

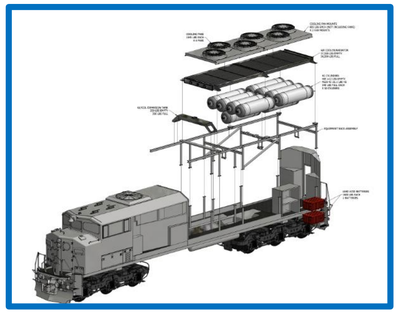
Q4 2022 – Hydrogen Locomotive – Revenue Customer Switched

24 Months



Conceptualization

Manufacturing



Assembly

Realization

Pre-Production

PHASE 1 - TESTING

Hydrogen DC Demonstrator

PHASE 1 – FIRST ZERO EMISSIONS CUSTOMER LIFT

Hydrogen DC Demonstrator

PHASE 1 – MAINLINE EXTENDED LOAD TESTING

Testing Summary

- ✓ Over 850 zero emission mainline miles achieved across 9 mainline tests
- ✓ Weekly testing in trains carrying over 20,000 tons shoving at 2350 HP
- ✓ Operation up to 50 MPH on mainline
- ✓ Revenue customer switched from North Calgary to Alyth
- ✓ Operation in extreme cold
- ✓ Draft against air brakes, ”kicking” cars

PHASE 2 – EXPANDED PROGRAM SCOPE

Additional Models & Fueling Facilities

CP 1001 – SD40-2 6-Axle DC

Jan 2020 – Jan 2022

Fabrication Complete
Field Trials

EMISSIONS REDUCTION ALBERTA

Government of Canada / Gouvernement du Canada

Low Carbon Economy Fund

CP 1002 – GP38-2 4-Axle DC

Apr 2022 – Nov 2022

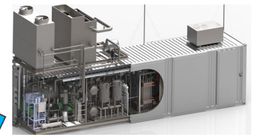
Fabrication Complete
First Movement Mar 21st, 2023

CP 1003 – AC4400CW AC

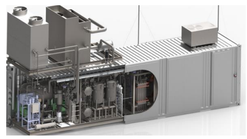
Jan 2023 – Sept 2023

Fabrication In-Progress
First Movement Sept, 2023

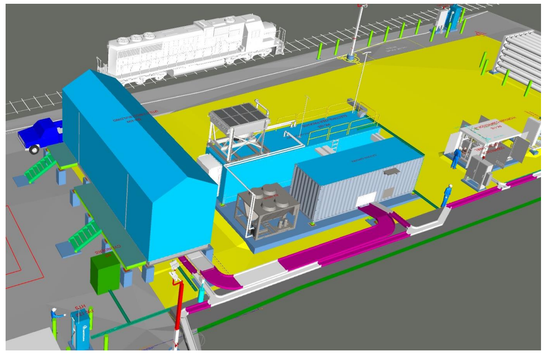
In Execution Phases

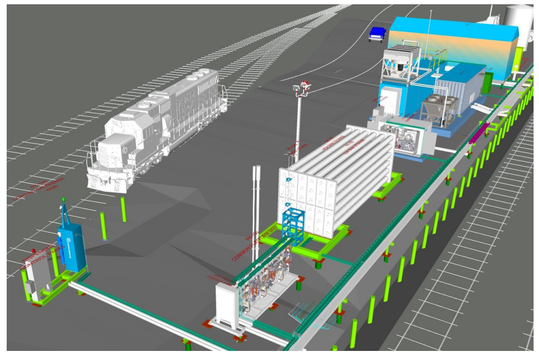


2023



2023





THANK-YOU

QUESTIONS?