Railroad GHG Emissions Reduction

Prepared for ASLRRA Mechanical Committee
By Wayne Kennedy
October 2023

301 and 302 lift about 20,000 tons over a crest near Able at Mile 9.21 South Sub. Sept.3/2010 *Tim Stevens*

Railway Age's 2023 Regional Railroad of the Year is the ArcelorMittal Infrastructure Canada (AMIC) Railway. (©ArcelorMittal)

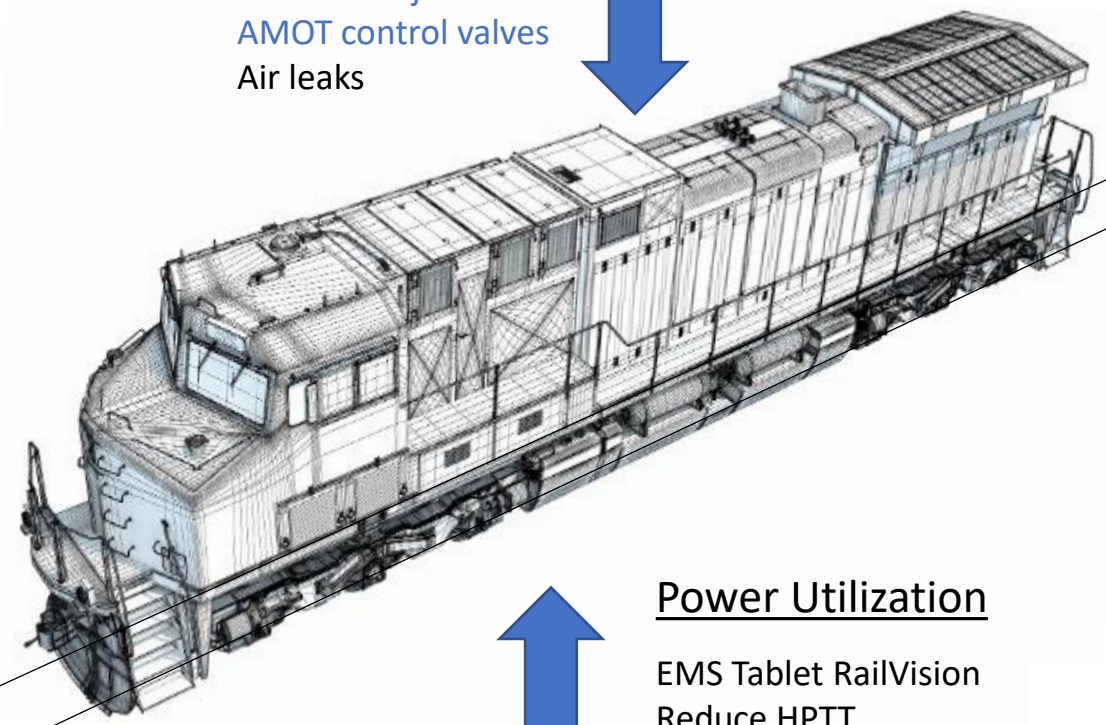
Locomotive Fuel Efficiency

Fuel Savings in the 1% to 3% range

Fuel Savings higher than 3%

Engine Efficiency

Fuel/oil additives
Friction modifiers
Railhead LED headlights
Good/bad actor ID
Premium injectors
AMOT control valves
Air leaks



Other

Unnecessary stop reduction
SpillX high speed refueling
Veridapt Fuel management
Fuel data analysis
Biofuels (GHG only)

Train Drag Factors

MPL Flange lube sticks
On-board TOR-FM
Wheel bearing seals
Wheel profile (AAR 2A)
Wayside TOR-FM

Power Utilization

EMS Tablet RailVision
Reduce HPTT
AESS (air leaks)
Throttle limitation
Reduce load testing
MLB Li+ Battery Starter Pack
Engineer Trng/Competition

What Affects Fuel Consumption Efficiency Rate

1. Measurement Accuracy
2. Commodity Mix
3. System Velocity
4. Unplanned Stops
5. Locomotive Fleet Age
6. Shutdown Compliance
7. Locomotive Productivity
8. Service Interruptions
9. Technology Application
10. Biofuel Percentage

GTM measurement inaccuracy, there are many avenues for data issues some timing related, others systemic in how the system was built – one large Class I RR spent over two years overhauling their system and even the new system still had systemic issues
Gallon measurement inaccuracy (spills, theft, thermal expansion / contraction considerations, timing errors, purchased vs burned)

Bulk is fuel efficiency friendly with Intermodal being the opposite given tonnage is in the denominator and x2 HPTT difference

Actual mainline movement velocity is far different from average "Engineer on" to "Engineer off" velocity which includes mainline stops
Velocity reported to the STB does not include yard dwell whereas railroad velocity reported on their website does include yard dwell

Measuring unplanned stops, both duration and frequency and analyzing the reasons and how to reduce both is critical to improving fluidity

Which units to store is usually made on the basis of reliability and not fuel efficiency, SwRI has documented a 17% swing in fuel efficiency within the same Tier group – what could a different decision save on fuel? Unless the unreliable units/models also burn the most fuel

AESS has historically not provided the level of benefit expected due to many reasons, air leaks being number one, followed by weak batteries, engine starter life considerations and intentional disabling of the system to name a few
Stationary shutdown is only one element of overall opportunity, mobile shutdown while in a power consist moving is another opportunity

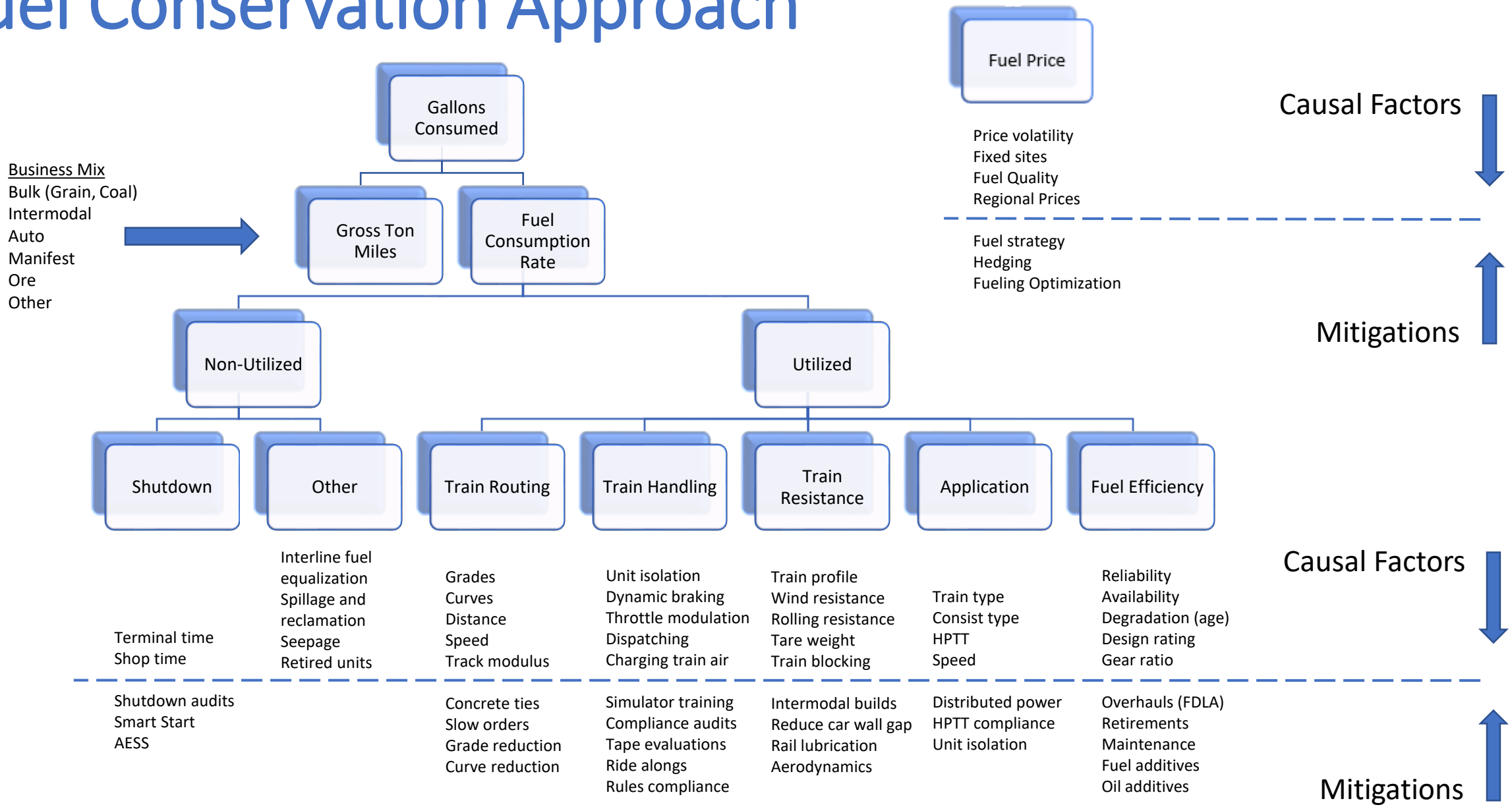
Only CN, CP and UP report this metric on their quarterly earnings and there is a large range between the Canadians and the sole US railroad in terms of GTM/HP with CN and CP approaching 200 and UP at 125 YTD 2022
Everyone makes a big deal about CN having virtually no grade as being the reason they can go so low on their HPTT metric, not so with the CP who have comparable grade to the UP – it's their very low HPTT (or high locomotive productivity performance) that saves fuel

Bad weather, derailments or just monster long trains with not enough sidings for them to fit are all reasons that railroads are more congested in a PSR world

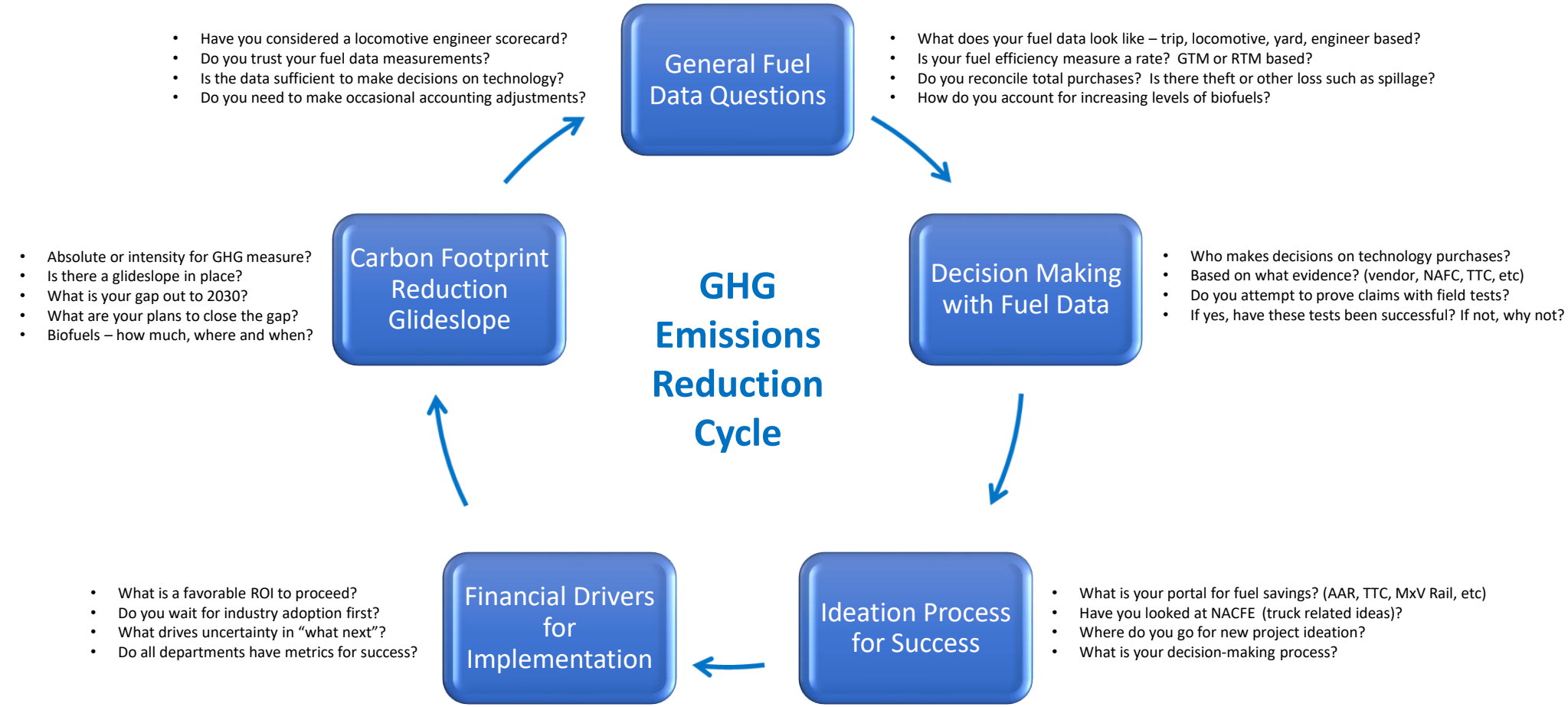
There are many technology applications, most of them locomotive based, that save fuel – many of them save fuel in the 1% to 3% range which is very difficult to prove in revenue service with notoriously inaccurate fuel gauges and a noise to signal ratio which is too large
Many railroads walk away from these technologies because they can't prove the fuel savings, even though testing has been done at TTC or other controlled environments such as SwRI – see page 2 for a list (which is the vast majority)

Many railroads desire the use of higher percentages of both biodiesel and renewable diesel to reduce their carbon emissions though the higher price will likely be unattractive in the short and perhaps long term
Another downside is the lower energy content of biofuels which will require more gallons purchased/consumed to provide the same amount of pulling power – this will help the emissions measure but will hurt the fuel efficiency measure unless accommodations can be made to account for lower energy content biofuel gallons

Fuel Conservation Approach



GHG Emissions Reduction Cycle



A continuous improvement cycle for ongoing GHG emissions reduction could look like this

Questions help to focus direction and create new possibilities and new ways to approach a problem