ALTO HSR CITIZEN RESEARCH INITIATIVE

ALTO: A CO_2 Rounding Error

What a high-speed railway contributes to transport decarbonisation, measured against the vehicles on the roads beside it.

Research note · November 2026 · Alto HSR Citizen Research Initiative

1. The Finding

ALTO is advanced, in part, as a climate measure. This note asks a question: how much carbon does it actually save, set against the other things happening to road transport in the same provinces over the same fifty years?

The answer is that ALTO is not a material decarbonisation instrument. Over the fifty operating years from its first phase opening in 2040 to 2089, at the Initiative's central ridership forecast and on a consistent life-cycle accounting boundary, ALTO is a net removal of 2.5 Mt CO_2e. Electrifying the car and light-truck fleet of Ontario and Quebec over the same period removes 1,097 Mt. Electrifying the heavy trucks removes a further 154 to 668 Mt, depending how fast long-haul freight converts.

ALTO is between 0.14 and 0.20 per cent of that total. At its upper ridership case — a forecast above every independent estimate for the corridor — it reaches 1.3 to 1.8 per cent. At its lower case it is not a saving at all: the railway emits more over fifty years than it displaces.

Table 1 Fifty-year carbon saving, 2040–2089, Ontario and Quebec. All figures on a life-cycle comparison boundary: every mode carries its fuel supply chain and its manufacturing, so the electrification figures are already net of battery production and ALTO's figure is already net of its 14.69 Mt of construction carbon. Negative means the measure emits more than it saves.

Measure	50-year saving	ALTO central as a share
Car and light-truck electrification, Ontario + Quebec	1,097 Mt	—
Heavy-truck electrification — slow (25% of long-haul by 2080)	154 Mt	—
Heavy-truck electrification — central (50% by 2080)	324 Mt	—
Heavy-truck electrification — fast (90% by 2080)	668 Mt	—
Combined road electrification, slow truck case	1,251 Mt	0.20 %
Combined road electrification, central truck case	1,422 Mt	0.17 %
Combined road electrification, fast truck case	1,765 Mt	0.14 %
ALTO, lower ridership (6.1M by 2080)	−8.3 Mt	—
ALTO, central ridership (12.5M by 2080)	+2.5 Mt	—
ALTO, upper ridership (25.7M by 2080)	+22.6 Mt	—

Put as time rather than tonnes: road electrification in these two provinces averages about 28 Mt a year across the period. ALTO's entire fifty-year net carbon removal is equivalent to roughly one month of it.

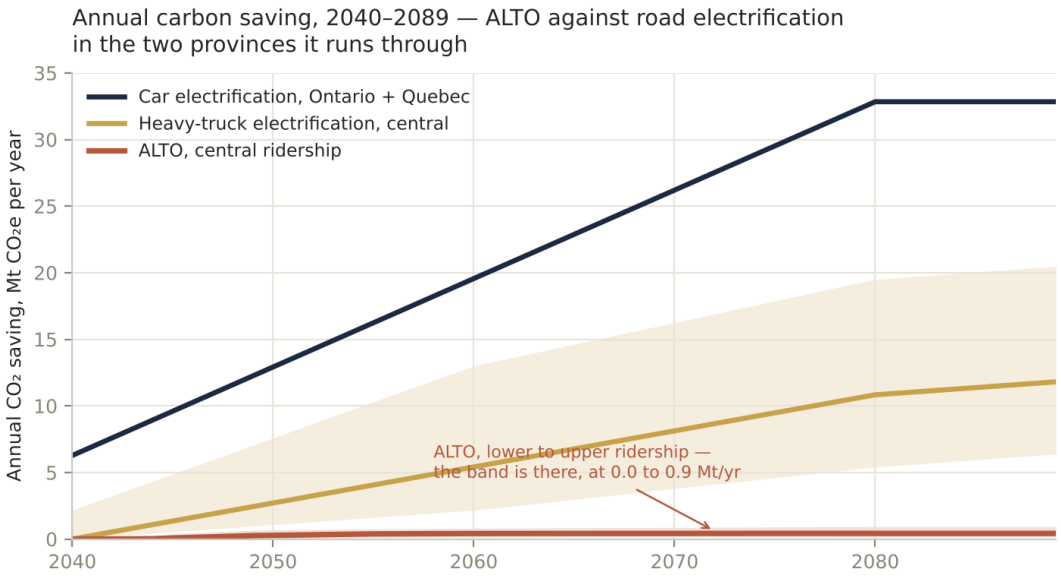


Figure 1 Annual carbon saving, 2040–2089. The shaded bands are each measure's full range: for heavy trucks, the slow and fast conversion cases; for ALTO, its lower and upper ridership forecasts. ALTO's band runs from 0.0 to 0.9 Mt a year and is not visually separable from the axis at this scale, which is the point of the chart rather than a defect in it.

2. What ALTO Saves

ALTO's saving is the difference between what its passengers would otherwise have emitted and what the railway emits instead, less the carbon spent building it.

The project opens in three phases — Montréal–Ottawa around 2040, Ottawa–Toronto around 2045, Montréal–Québec City around 2050 — and incurs construction carbon at each. The central estimate for the full 1,000 km corridor is 14.69 Mt CO_2e, with a range of 6.87 to 29.60 Mt. Operations over fifty years add a further 2.9 Mt, and permanently severed rural roads a further 0.19 Mt.

Against that, the displaced trips. On the Initiative's central ridership trajectory the corridor carries 0.4 million passengers in 2040, 9.2 million by 2055 and 12.5 million by 2080, at a demand-weighted average trip of 430 km. Crediting those trips at the life-cycle intensity of the modes they replace — cars, short-haul aircraft, and the existing VIA Rail service — gives 20.2 Mt of displaced emission over the fifty years.

Table 2 ALTO's fifty-year carbon account, central ridership, IESO 2025 grid outlook, life-cycle comparison boundary. Positive is emission, negative is saving.

Component	Mt CO_2e
Construction, one-time, central estimate	+14.69
Traction, 50 years	+0.52
Fixed operational — stations, maintenance, winter operations	+2.29
Road severance, 50 years	+0.19
Passenger modal shift, 50 years	−20.15
Net fifty-year balance	−2.46

Two features of that account govern the result. The debt is front-loaded and the repayment is back-loaded: the concrete is poured in the 2030s and 2040s, the passengers arrive in the 2060s and 2070s. And the credit is shrinking, because it depends on the carbon intensity of the cars it displaces, which is falling as the fleet electrifies. ALTO does not repay its construction carbon until 2083, six years before the fifty-year operating period closes.

Figure 2 traces that balance year by year, and it also shows what the accounting boundary does to it. Everything else in this note is reported on the life-cycle boundary, in which every mode carries its fuel supply chain and its manufacturing. The narrower tailpipe boundary counts only what comes out of the exhaust while travelling — no refinery, no factory, no battery. Measured that way the displaced cars look cleaner than they are, ALTO's credit shrinks, and its payback moves from 2083 to 2110. The dashed lines show it. Neither boundary is wrong; mixing them is, and the gap between each solid line and its dashed partner is a choice about what to count rather than a disagreement about the railway.

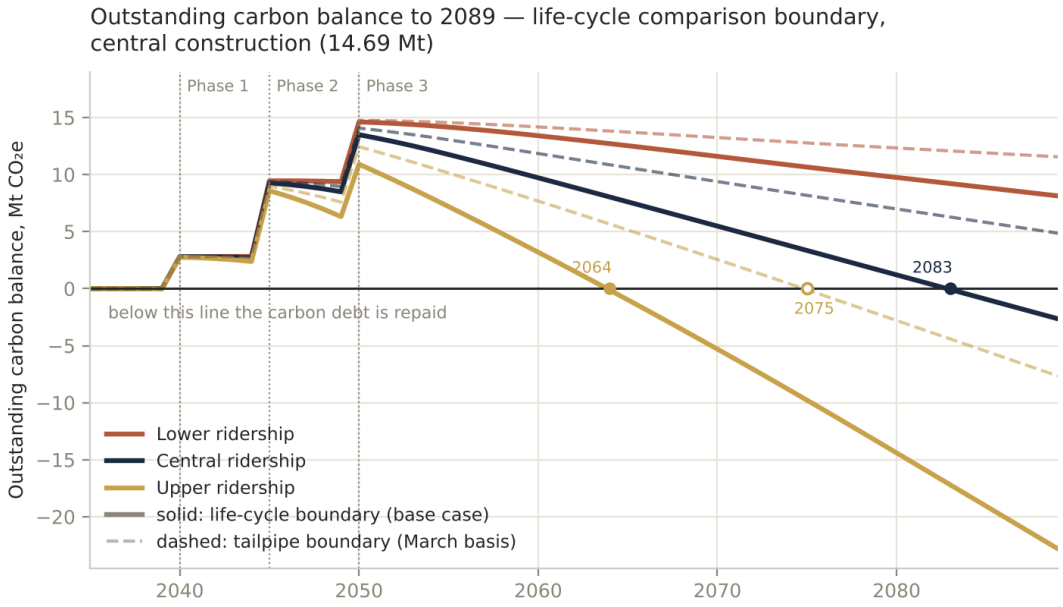


Figure 2 Outstanding carbon balance over the fifty operating years to 2089. Solid lines are the life-cycle comparison boundary, dashed lines the same three ridership trajectories measured at the tailpipe; IESO grid path throughout. Above the line the project has not yet repaid the carbon spent building it, and each step is a phase opening. On the life-cycle boundary the central trajectory crosses in 2083 and the upper in 2064; at the tailpipe the upper crosses in 2075 and the central not until 2110. The lower trajectory does not cross on either boundary. Road severance is accounted separately and is not included in these balances.

3. What Road Electrification Saves

The comparison is built from the same inventory the federal government uses, and the same accounting boundary applied to ALTO.

Natural Resources Canada's Comprehensive Energy Use Database reports GHG emissions by transportation mode and province. For cars and passenger light trucks the two provinces together emit 39.0 Mt a year as inventoried — Ontario 24.0 Mt in 2022, Quebec 15.0 Mt in 2023. Heavy freight trucks add 18.2 Mt — Ontario 11.8, Quebec 6.4. Those are combustion figures; on the life-cycle boundary, which adds fuel extraction, refining and distribution and the manufacture of the vehicle itself, they become 63.6 and 22.9 Mt a year.

Electrifying a car removes 76 per cent of its life-cycle emission on Ontario's grid: 176 g per passenger-kilometre for an internal-combustion vehicle against 42 g for an electric one, the latter almost entirely battery manufacture rather than electricity. That figure is corroborated independently by TD Economics, which puts the Ontario saving at "around 80 per cent". Electrifying a heavy truck removes 94 per cent — a battery-electric Class 8 at roughly 63 g per kilometre against diesel's 1,134 g — because a 600 kWh battery is a far larger manufacturing debt than a car's, but amortises over a 1.2 million kilometre working life.

Table 3 Inputs to the electrification comparison. Road emissions from NRCan Table 8; life-cycle multipliers from Chester and Horvath (2009); grid intensity from the IESO 2025 Annual Planning Outlook. The fleet is held at today's emission level across the period, on the assumption that growth in vehicle-kilometres and improvement in conventional efficiency broadly offset.

Input	Value	Basis
Cars and light trucks, ON + QC	39.0 Mt/yr	NRCan Table 8, Ontario 2022 and Quebec 2023
Heavy freight trucks, ON + QC	18.2 Mt/yr	NRCan Table 8
Life-cycle multiplier, road passenger	1.63	Chester and Horvath (2009)
Life-cycle multiplier, road freight	1.26	Chester and Horvath (2009)
Emission removed, car to electric	76 %	176 → 42 g/pkm, IESO grid
Emission removed, Class 8 to electric	94 %	1,134 → 63 g/km, 1.2M km life
EV fleet share, cars, 2040 → 2080	15 % → 70 %	post-repeal trajectory
Electrification counterfactual	2 % EV fleet, held	today's fleet, frozen

The car trajectory used here is the post-repeal one. The federal Electric Vehicle Availability Standard, which required all new light-duty sales to be zero-emission by 2035, was paused in September 2025 and its repeal posted in the Canada Gazette in August 2026 with nothing in force to replace it. This note therefore models a slower fleet conversion than federal policy intended — which makes the electrification figures conservative, not generous.

That gap is itself instructive. Restoring the mandate's original trajectory would save a further 165 Mt over the same fifty years in these two provinces alone. One regulatory decision about car sales is worth roughly sixty-seven times ALTO's entire fifty-year net carbon removal.

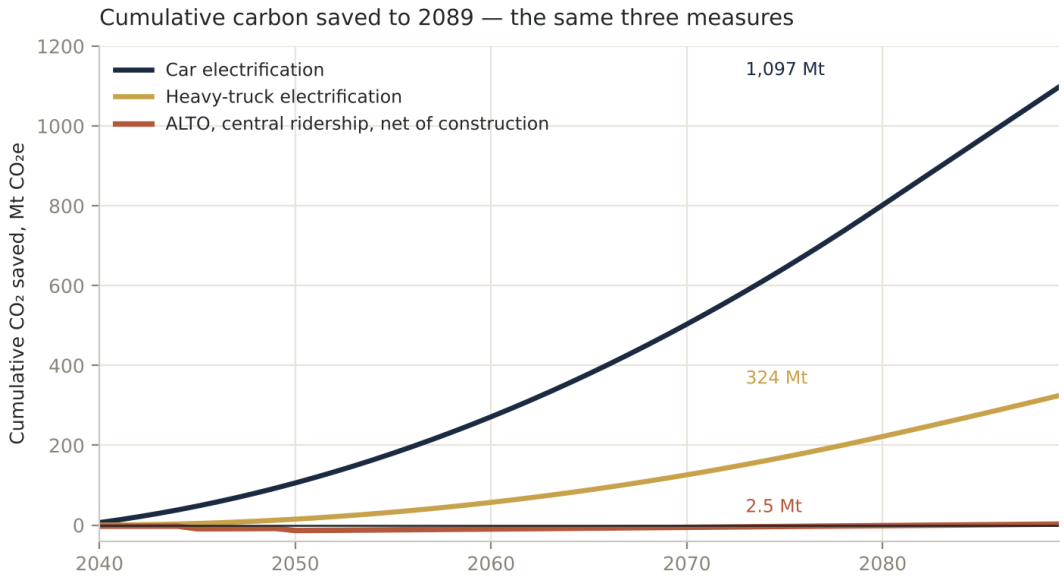


Figure 3 Cumulative carbon saved to 2089. ALTO is drawn net of its construction carbon, so that it is on the same footing as the electrification lines, whose 76 and 94 per cent reductions are already net of battery manufacture. ALTO's line is below zero until 2083.

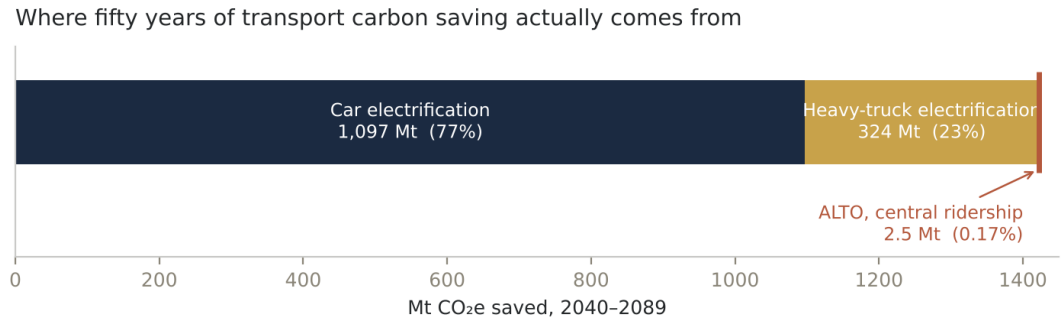


Figure 4 The same three measures as shares of the fifty-year total, central cases. ALTO is the red marker at the right-hand end of the bar. It is drawn to scale.

4. What This Does and Does Not Show

Four qualifications belong with the comparison, and the first is the one a reviewer will raise.

These are not alternatives, and the figures do not compete. Building a railway does not prevent electrifying a car fleet, and nothing here says the money should move from one to the other. The two savings add. The comparison establishes proportion, not a choice: it says what weight the carbon argument can bear in a case for ALTO, not whether ALTO should be built.

The figures do not double-count. ALTO's credit is calculated on the electrification trajectory — that is precisely why it erodes over the period, and why its saving per passenger falls from about 57 to about 22 grams per passenger-kilometre between 2050 and 2080 on the operational boundary. The displaced car is getting cleaner whether or not the railway is built.

The electrification counterfactual is artificial. Holding the fleet at a 2 per cent electric share for fifty years is not a forecast of anything; it is a device for measuring what conversion delivers. The realistic

question is not whether electrification happens but how fast, which is why the car trajectory is taken from post-repeal policy rather than from ambition.

The scope is deliberately narrow. Ontario and Quebec road transport only, light-duty and heavy freight. It excludes medium trucks, marine, aviation and rail, and it excludes the rest of Canada. A wider scope would make ALTO's share smaller, not larger.

What remains after all four qualifications is a question of proportion that the project's climate framing does not survive. A railway costing well over $100 billion on the Initiative's own reference-class estimate, which does not repay its own construction carbon until 2083, removes in fifty years what the vehicle fleet beside it removes in about a month. If ALTO is to be justified, it will have to be justified on capacity, on journey time, or on regional development. It cannot be justified on carbon.

5. Sources

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- Natural Resources Canada, Office of Energy Efficiency, Comprehensive Energy Use Database, Transportation Sector Table 8: GHG Emissions by Transportation Mode — Ontario (2022) and Quebec (2023) — oee.nrcan.gc.ca
- M. Chester and A. Horvath, "Environmental assessment of passenger transportation should include infrastructure and supply chains", Environmental Research Letters 4 (2009) — the life-cycle multipliers over tailpipe-only accounting — transportationlca.org
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