CITIZEN RESEARCH INITIATIVE · FINANCIAL ANALYSIS

ALTO : The Financial Reality

An annual fiscal ledger framework applied to the ALTO corridor, drawing on the modal-shift, ridership-envelope, subsidy-frontier, and NPV evidence base.

The question

ALTO's published targets are **24 million annual passengers by 2055, rising to 43 million by the 2080s**. Are these claims financially defensible? This deck integrates the modal-shift framework, the engineering ground-up O&M build, and the three-perspective NPV analysis.

The basic economic framework

Every rail corridor must balance the annual fiscal ledger — the question is who pays for the gap

COSTS — what the corridor must pay each year

REVENUE — where the money comes from

Annual debt service on capital
(capex × CRF)

+

Annual O&M + fleet capital
(operating cost)

=

Annual farebox revenue
(ridership × fare)

+

Public subsidy (federal + provincial)
(closes the gap)

+

Land value Capture (Annual LVC sstream)
(closes the gap)

CAPEX Debt service + O&M = Farebox revenue + Public subsidy + LVC

Each piece is independently anchored

Debt service is set by capex and cost of capital. O&M is set by Note 3 engineering. Revenue is set by ridership times fare. None can be adjusted independently of the others.

Subsidy is whatever closes the gap

The public pays whatever costs exceed farebox revenue. Subsidy is bounded above by total cost (cannot be negative) and below by zero (cannot pay riders to board).

No fare posture eliminates the bill

Raising fares cuts ridership; lowering fares cuts revenue per rider. The next slides show the resulting tradeoff across the achievable ridership range.

Framework underlies Notes 3 and 4 · the next five slides put numbers on each piece

ALTO HSR CITIZEN RESEARCH INITIATIVE · METHODOLOGY

The seven-stage analytical pipeline

Each stage produces a defensible value for one term in the annual fiscal ledger — calibrated against the empirical reference class or built bottom-up from engineering specification

PREDICTORS · STAGES 1–2

1 **Engineering Complexity Index (ECI)**

Ten-dimension weighted scoring of corridor physical-engineering complexity against the international reference class

2 **Community Friction Index (CFI)**

Five-component scoring of governance, consultation, and consent risk, with a four-year trajectory projection

THREE PARALLEL REFERENCE-CLASS AND ENGINEERING INPUTS · STAGES 3–5

3 **Reference-class capital cost**

Probabilistic capex distribution calibrated by ECI and CFI against the empirical cost-overrun literature

4 **Engineering ground-up O&M**

Bottom-up build from asset inventory and service-level inputs across three streams — independent of the capex figure

5 **Reference-class modal-shift**

Independent ridership envelope, operating-regime structure, and subsidy frontier from air-rail and road-rail S-curves

INTEGRATION AND VERDICT · STAGES 6–7

6 **NPV / Benefit-Cost Analysis**

BCR at three discount rates; iso-BCR analysis of the (ridership, fare) parameter space across three capex scenarios

7 **Institutional review (QA1 / QA2)**

Pass/fail assessment against the eight Norwegian QA1 criteria and six QA2 forward-assessment criteria

ALTO HSR CITIZEN RESEARCH INITIATIVE

CAPEX: Engineering Complexity and Community Friction

Joint Predictors of High-Speed Rail Cost

A multivariate reference-class analysis of 16 international HSR projects, with cost predictions for the ALTO corridor and the HPR alternative

Briefing deck · April 2026

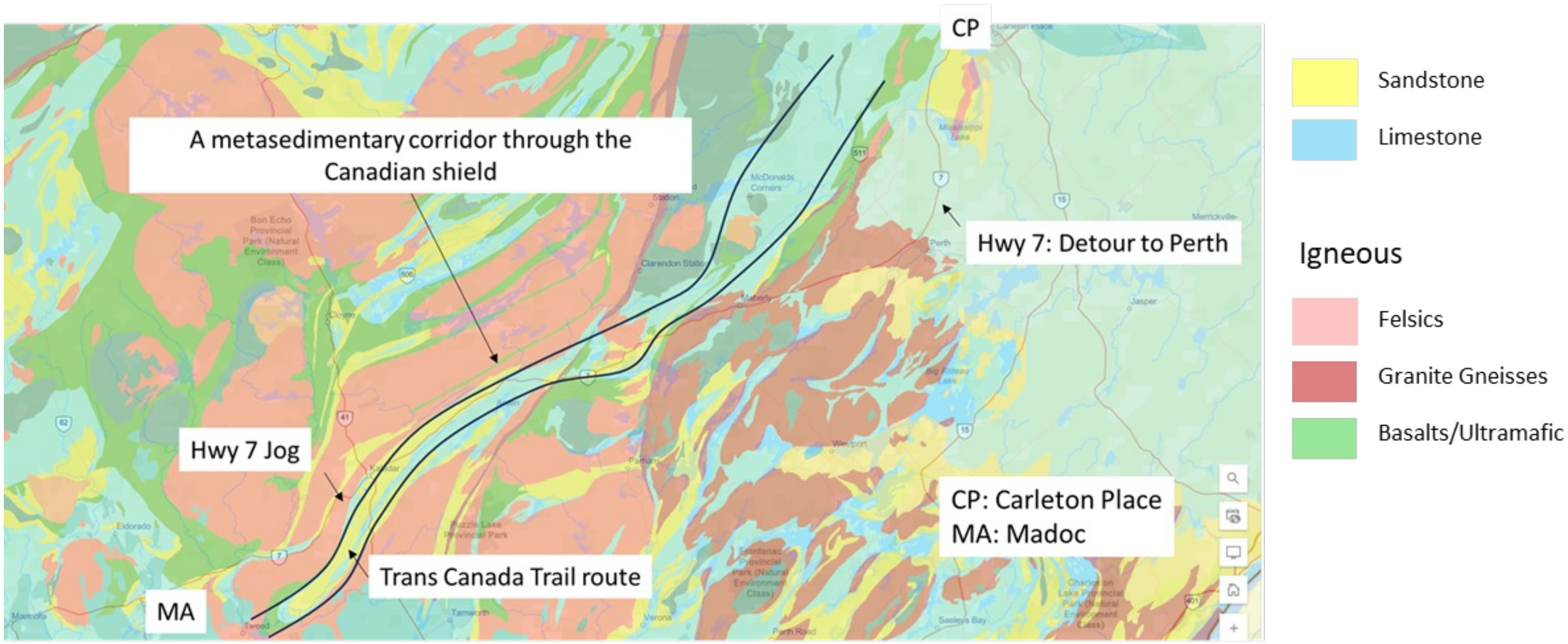
altohsrcitizenresearch.ca · citizenresearch.ca

PREDICTORS OF COST

STAGE 1
Engineering Complexity Index (ECI)

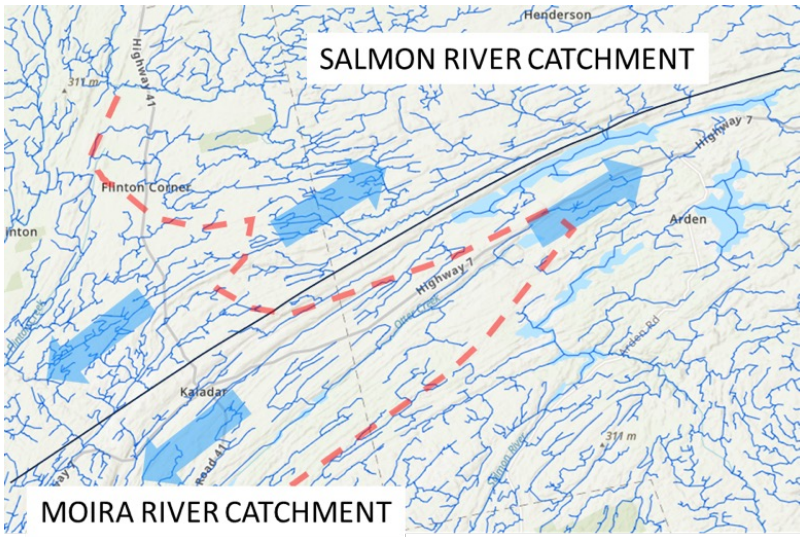
Ten-dimension weighted scoring of corridor physical-engineering complexity, calibrated against the international reference class

A six-dimension weighted index for engineering complexity

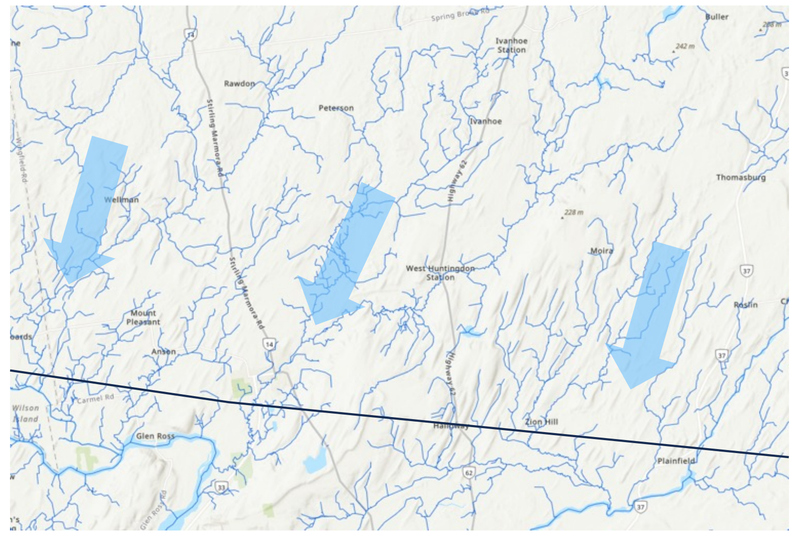


HYDROLOGICAL BACGROUND

3-5,000 Billion litres of Water Cross the Railway



Northern Route



Southern Route

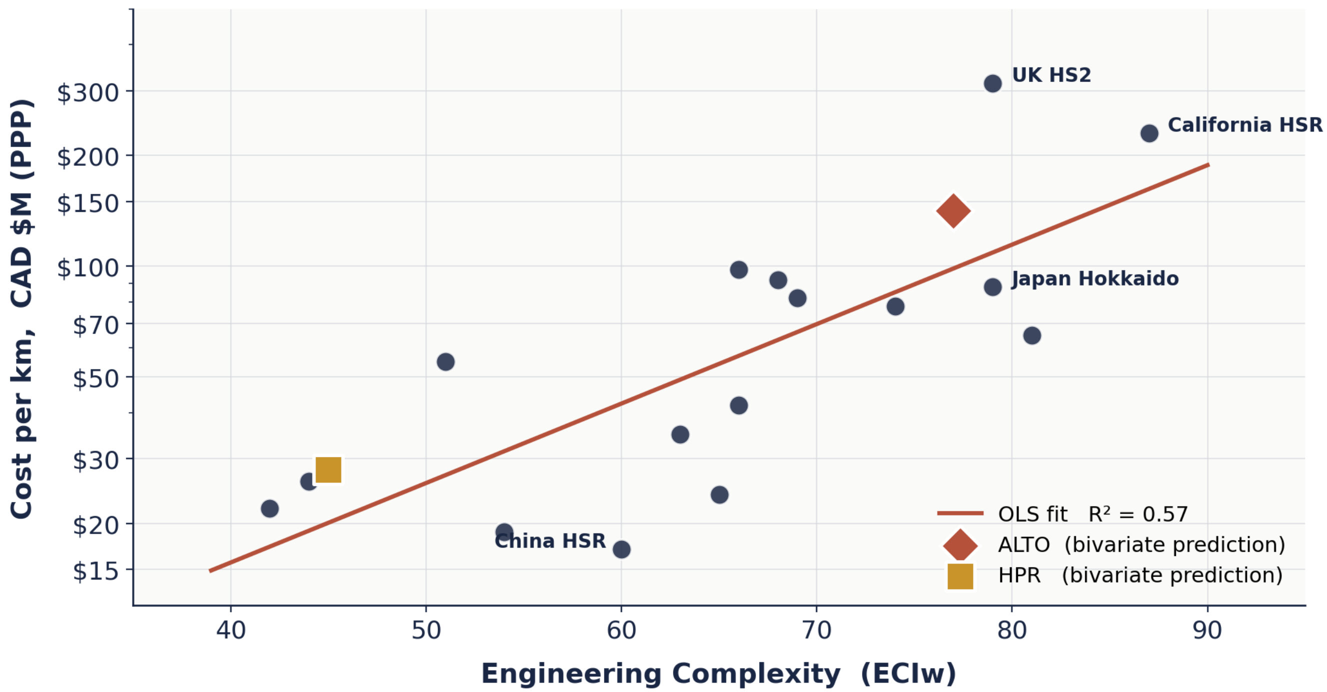
The Engineering Complexity Index (ECI)

A six-dimension weighted index for engineering complexity

DIMENSION	WEIGHT	1 — ROUTINE	3 — MODERATE	5 — EXTREME
Geotechnical conditions	20	Competent uniform ground, shallow stable bedrock	Mixed conditions, moderate settlement potential	Karst, sensitive marine clays, liquefaction, shear zones
Major structures	20	Minimal — at-grade with small culverts	Short bridges, one grade separation cluster	Long viaducts, deep or long tunnels, major river bridges
Topography and alignment	20	Flat, straight, generous curve radii	Rolling, some grade or curve compromises	Mountainous or constrained; grades and radii at spec limits
Hydrology and drainage	15	Few minor crossings, simple culverts	Several regulated watercourses, some floodplain	Major river crossings, wetland complexes, altered groundwater
Infrastructure interfaces	15	Greenfield, few conflicts	Several road, rail, or utility crossings	Dense urban interfaces, live rail, buried utilities
Climate and environmental loading	10	Temperate, low freeze-thaw, stable	Cold climate, moderate frost heave, snow loading	Severe freeze-thaw, permafrost-adjacent, extreme swing

Physical engineering dimensions carry 60 % of total weight

Cost rises with engineering complexity — but with wide scatter



R^2

0.57

of cross-project variance in log-cost explained by EClw alone

Takeaway

Engineering complexity is a real cost driver, but leaves 43 % of variance unexplained — notably the anglophone premium (HS2, HS1, California).

$$\log_{10}(\text{cost CAD M / km}) = 0.0173 \cdot \text{EClw} + 0.666$$

n = 20 HSR reference projects · cost in 2026 PPP Canadian dollars

ALTO HSR CITIZEN RESEARCH INITIATIVE

The ALTO Community Friction Index (CFI)

Key figures from the April 2026 research note

Briefing deck · April 2026
citizenresearch.ca · altohsrcitizenresearch.ca

PREDICTORS OF COST

STAGE 2

Community Friction Index (CFI)

Five-component scoring of governance, consultation, and consent risk, with a four-year trajectory projection across the construction window

THE FACE OF COMMUNITY FRICTION

What does Community Friction Look like?

#SaveSouthFrontenac
No high-speed train in the southern corridor

SAVE STONE MILLS
NO ALTO HIGH-SPEED RAIL

Five factors that make up the CFI

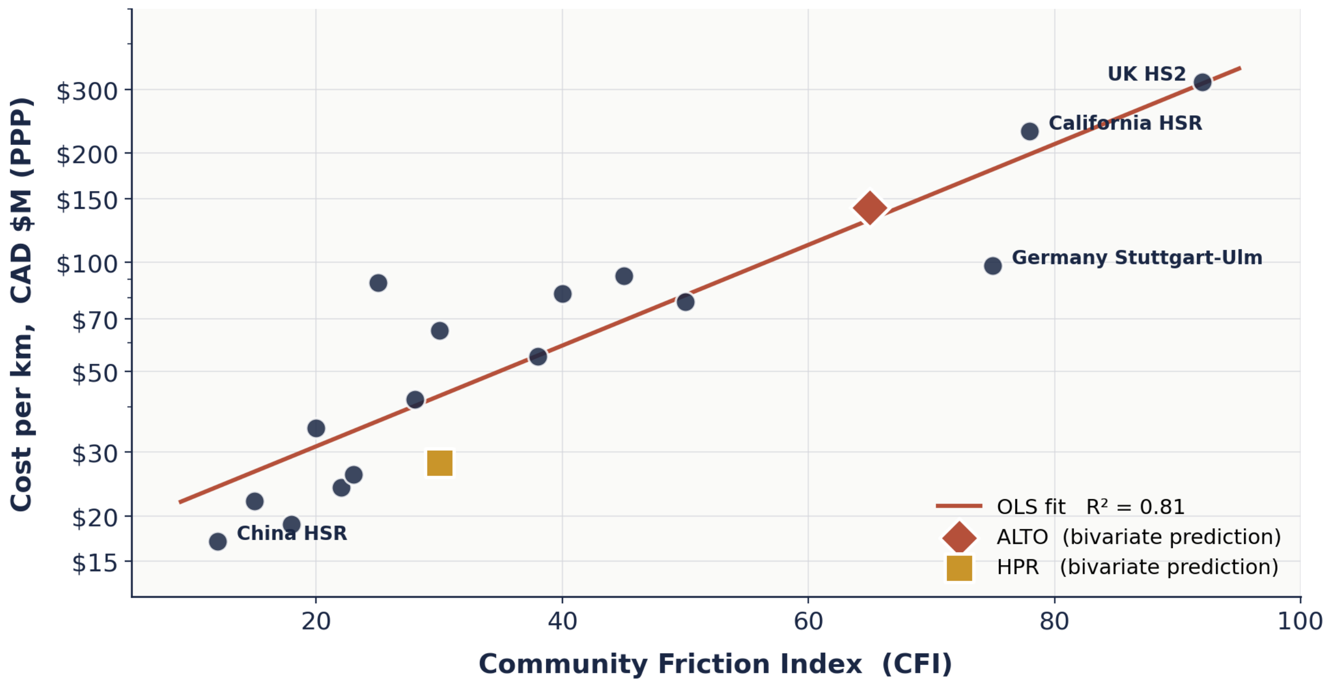
Each component scored 0-20 from the documented record · Five components sum to the aggregate CFI (0-100)

#	Factor	Measured by
1	**Public opposition intensity** *Scale, organisation, and reach of grassroots opposition.*	Consultation record · community groups · media coverage · public mobilisation
2	**Legal challenges filed** *Formal legal and quasi-legal activity against the project.*	ATI requests · tribunal applications · judicial review · injunctions · s. 35 litigation
3	**Forced route changes** *Cumulative scope, alignment, or category changes under pressure.*	Realignments · station relocations · speed downgrades · phase cancellations
4	**Environmental / NGO opposition** *Intensity of environmental and NGO engagement with the project.*	EA submissions · species-at-risk triggers · regulator intervention · stop-work orders
5	**Political traction** *Inter-party, inter-governmental, or intra-caucus political contest.*	Parliamentary inquiries · committee hearings · election-issue status · intergovernmental dispute

5 components × 0-20 sub-scale = Aggregate CFI (0-100)

UNIVARIATE FIT · COMMUNITY FRICTION

Community friction is the stronger single predictor of HSR cost: PEOPLE ARE HARDER THAN ROCK!



R^2

0.81

of cross-project variance in log-cost explained by CFI alone

Takeaway

CFI alone explains more variance than any engineering-only model. Sociopolitical cost pathways are independently measurable.

$\log_{10}$ (cost CAD M / km) = 0.0139 · CFI + 1.216 *n = 16 HSR reference projects · cost in 2026 PPP Canadian dollars*

METHODOLOGY · AN INTUITION FOR BIVARIATE FIT

A housing analogy: two factors, one price

A house's price is driven by both its size and its location — a rail corridor's cost is driven by both its engineering complexity and its community friction

"**Location, location, location**" is the fundamental real estate mantra that a property's desirability, value, and appreciation are primarily determined by its position, rather than the house itself.

Takeaway Neither dimension alone tells the whole story. Size without location under-explains price; ECI without CFI under-explains HSR cost. Together, they capture 90 % of cross-project variance.

HOUSE PRICE

depends on two independent dimensions

Size

square footage · bedrooms · bathrooms

Location

waterfront · proximity to schools · proximity to HSR tracks

ALTO COST PER KM

depends on two independent dimensions

Engineering complexity ECI

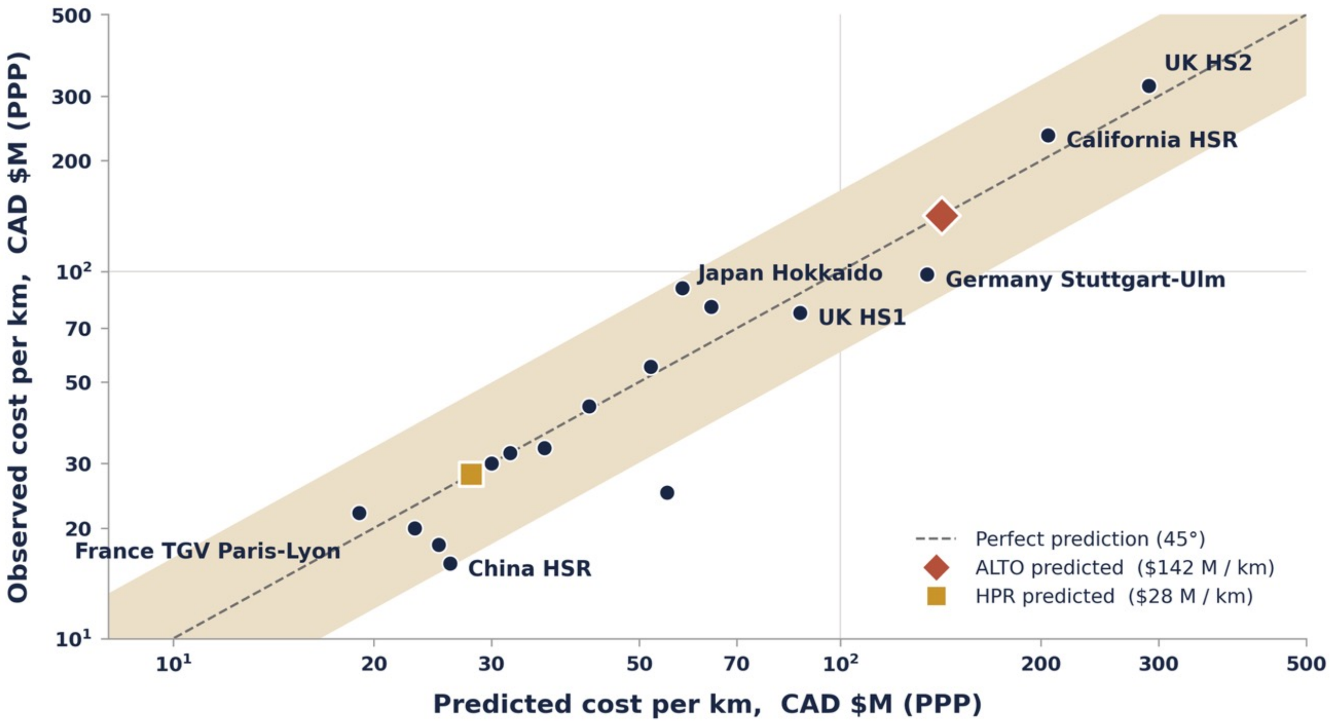
geotechnical · structures · topography

Community friction CFI

consultation · land tenure · environmental · cost-scope · political

JOINT MODEL · PREDICTED vs OBSERVED

Together, ECIw and CFI explain 90 % of cross-project cost variance: How much will ALTO Cost?



R^2

0.90

bivariate model · adj $R^2 = 0.88$
$F(2, 13) = 56.9$, $p < 10^{-6}$

Coefficients

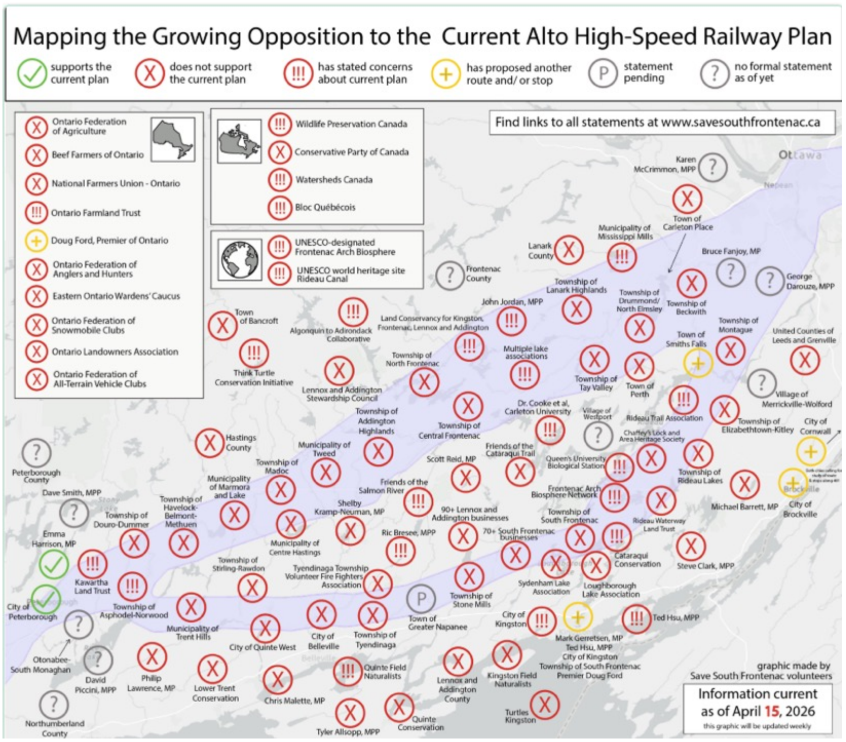
ECIw	$p = 0.006$	$\beta = 0.35$
CFI	$p < 0.001$	$\beta = 0.70$
Year	*$p = 0.83$*	*(not sig.)*

$\log_{10}$(Predicted Cost per km)= 0.0101 · ECIw + 0.0108 · CFI + 0.671 *adj $R^2 = 0.88$ · completion year adds nothing once both indices are controlled for*

Current CFI: 43

Moderate band · 25 to 45

Post-Bill C-15 baseline, April 2026 · Two points below the High threshold



Principal evidence by component

Public Opposition· 16
Cross-sector coalition; parliamentary testimony on ALTO-specific C-15 provisions.

Political Traction· 11
Senate pre-study across 10 committees; 82 report-stage amendments.

Environmental · 9
Coordinated NGO objections; SARA engaged as primary statutory protection.

Legal · 5
Coordinated ATI programme across HICC, TC, PSPC, VIA Rail.

Route · 2
Pre-consultation; C-15 s. 98 CTA deeming suppresses this component.

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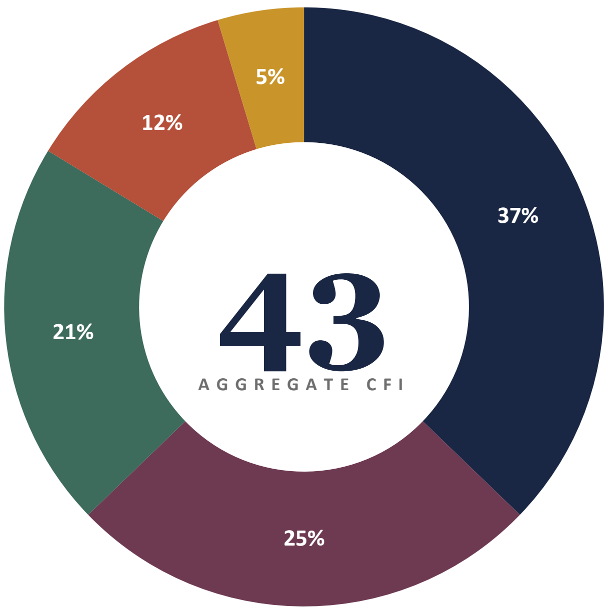

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Eight drivers of friction intensification

Repeatable conditions that move a project up the regression line · Multiple conditions together push scores into Very high and Extreme bands

1. **Tokenistic or premature consultation**

   Announcing a preferred corridor before genuine engagement converts stakeholders into adversaries. HS2 and California HSR both followed this pattern.

2. **Route through farmland and established communities**

   Linear severance of agricultural land and rural properties generates durable opposition. Rural communities have the cohesion and time to sustain multi-year campaigns.

3. **No Transparency in corridor selection methodology**

   Where the technical basis for alignment is not disclosed, communities fill the vacuum with worst-case assumptions. ATI requests escalate; political risk multiplies.

4. **Expansive or novel expropriation frameworks**

   Exceptional acquisition powers granted before environmental approval are experienced as an inversion of due process, attracting civil-liberties solidarity.

5. **Business case credibility gaps**

   BCR visibly below standard appraisal thresholds gives opponents a legitimising narrative that attracts fiscal-conservative allies (Flyvbjerg et al., 2002).

6. **Species-at-risk and ecological conflicts**

   SARA listings confer standing on environmental organisations and generate mandatory consultation obligations incompatible with project schedules.

7. **Station location and community bypass**

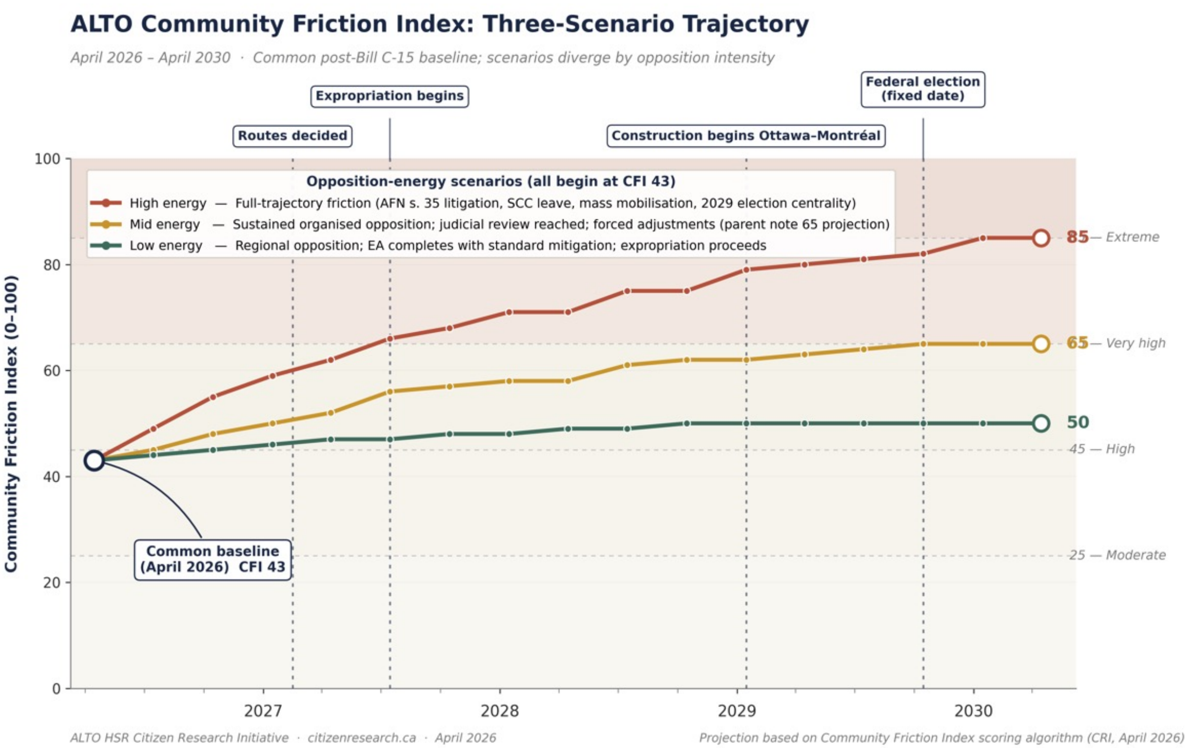
   Remote interchange stations remove potential beneficiaries from the supporter base, creating a durable perception that the project serves external logic.

8. **Delay and cost overrun signals**

   Each rescaling event increases friction. HS2 truncations and California HSR rebaselinings both reset scores upward with every announcement.

Four-year trajectory: three scenarios

All three begin at CFI 43 · Mid-energy endpoint (65) matches the parent note projection



HIGH · CFI 85

Extreme level

AFN s. 35 litigation, SCC leave, mass mobilisation, 2029 election centrality.

MID · CFI 65

Very high level

Sustained organised opposition; judicial review reached; forced adjustments.

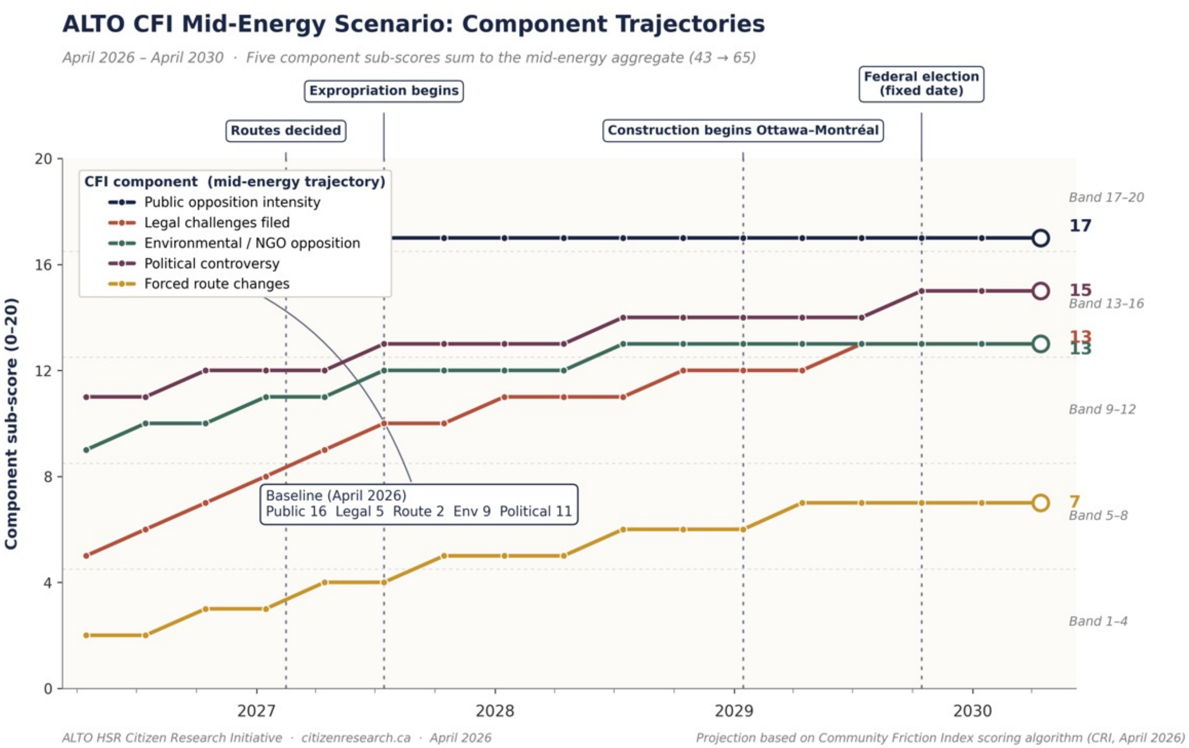
LOW · CFI 50

High level

Regional opposition; EA completes with standard mitigation.

Mid-energy: what drives the trajectory

Five component sub-scores sum to 43 → 65 · Legal challenges do most of the work



Reading the decomposition

Legal +8

Steepest riser. C-15 closes parliamentary channels; litigation is primary pressure point.

Political +4

Dampened through 2027-28 (majority insulation); bumps at October 2029 election.

Environmental +4

Plateaus at 13. Higher indicators require SARA stop-work or Indigenous parallel action.

Route +5

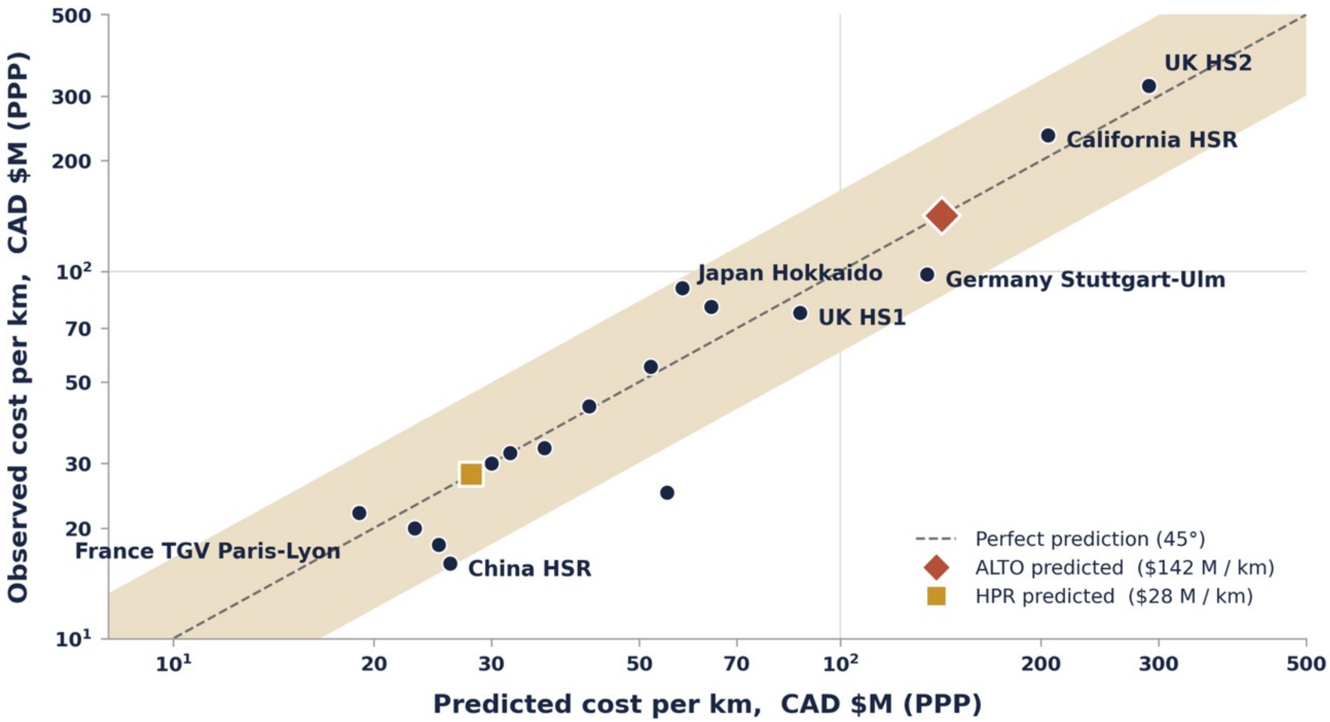
Slowest riser. s. 98 CTA deeming caps this component by statute.

Public +1

Near-flat: mid-energy assumes organised but non-mass-mobilisation opposition.

JOINT MODEL · PREDICTED vs OBSERVED

Together, EClw and CFI explain 90 % of cross-project cost variance: How much will ALTO Cost?



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Log_{10}(Predicted Cost per km)= 0.0101 · EClw + 0.0108 · CFI + 0.671 CAD $M(PPP) *adj $R^2 = 0.88$ · completion year omitted*

THREE PARALLEL REFERENCE-CLASS AND ENGINEERING INPUTS

STAGE 3

Reference-class capital cost estimation

Probabilistic capex distribution calibrated by ECI and CFI against the empirical cost-overrun literature — central, P85, and P97.5 reported

CONCLUSIONS · PROBABILISTIC ASSESSMENT

ALTO's $75 B declared cost lies at the lower 2.5 percentile of the reference-class prediction

The model's central estimate is $143 B; the proponent's own figure coincides with the bottom edge of the 95 % prediction interval

REFERENCE-CLASS CENTRAL PREDICTION

$142 B

central · 95 % PI $76 – 264 B · over 1,000 km
EClw = 77 · CFI = 65

ALTO DECLARED PROJECT COST

$75 B **(mid. $60-90B)**

2.5th percentile · a 1-in-40 outcome under the model

95 % PREDICTION INTERVAL · log-normal, symmetric in log space

$76 B · lower 2.5%
ALTO declared $75 B falls at this boundary

$142 B · central (50%)
joint EClw + CFI model prediction

upper 2.5% · $264 B
upper prediction bound

Takeaway The proponent's own cost estimate coincides with the most extreme lower-bound outcome the reference-class model treats as plausible — roughly a 1-in-40 probability the corridor actually comes in at or below $75 B.

EVIDENCE · CONSORTIUM SNAPSHOT

ALTO at the consultation deadline

Communications-heavy staffing and missing project materials at the April 24 deadline

DISCLOSED STAFFING ALLOCATION

36 communications staff

2 environmental scientists

42 land negotiation staff

10 environmental & regulatory

NO CREDIBLE MATERIALS YET PUBLISHED

construction costs · schedules · ridership forecasts · revenue models · operating costs · risk and opportunity analysis · Cadence consortium agreement

LEADERSHIP TURNOVER AND PUBLIC SCRUTINY

Air Canada CEO Michael Rousseau has announced retirement by September.

ALTO representatives reported to be departing amid backlash and sharper public questioning.

Residents, media and municipal bodies pressing for substantive answers.

Takeaway The public-facing footprint of the project outsizes its technical and environmental capacity — with the core deliverables of a credible consultation still absent at the deadline.

THREE PARALLEL REFERENCE-CLASS AND ENGINEERING INPUTS

STAGE 4

Engineering ground-up O&M cost estimation

Bottom-up build from asset inventory and service-level inputs across three streams — independent of the proponent's capex figure

The basic economic framework

Every rail corridor must balance the annual fiscal ledger — the question is who pays for the gap

COSTS — what the corridor must pay each year

REVENUE — where the money comes from

Rearranged, the public subsidy is whatever the farebox cannot cover:

Public subsidy = (Debt service + O&M) − Farebox revenue

Each piece is independently anchored

Debt service is set by capex and cost of capital. O&M is set by Note 3 engineering. Revenue is set by ridership times fare. None can be adjusted independently of the others.

Subsidy is whatever closes the gap

The public pays whatever costs exceed farebox revenue. Subsidy is bounded above by total cost (cannot be negative) and below by zero (cannot pay riders to board).

No fare posture eliminates the bill

Raising fares cuts ridership; lowering fares cuts revenue per rider. The next slides show the resulting tradeoff across the achievable ridership range.

Framework underlies Notes 3 and 4 · the next five slides put numbers on each piece

The basic economic framework

Every rail corridor must balance the annual fiscal ledger — the question is who pays for the gap

COSTS — what the corridor must pay each year

REVENUE — where the money comes from

Annual debt service on capital	+	Annual O&M + fleet capital	=	Annual farebox revenue	+	Public subsidy (federal + provincial)	+	Land value Capture (Annual LVC stream)
(capex × CRF)		*(operating cost)*		*(ridership × fare)*		*(closes the gap)*		*(closes the gap)*

CAPEX Debt service + O&M = Farebox revenue + Public subsidy + LVC

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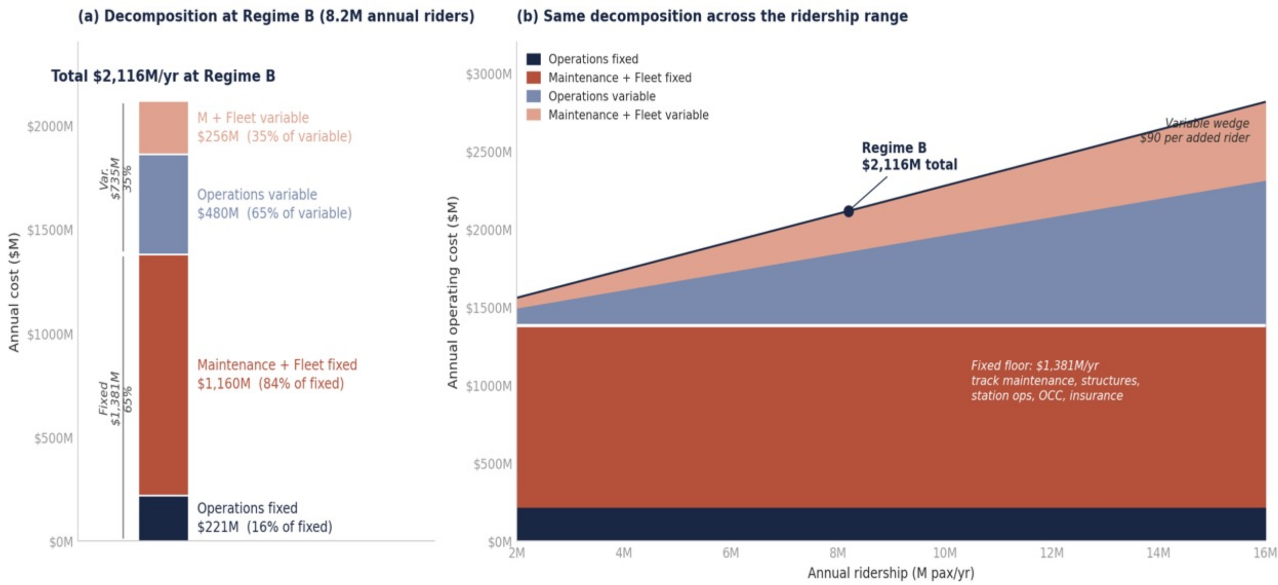
The operating cost build: Operations and Maintenance

Most of the annual cost is fixed — the corridor incurs it regardless of ridership



Note 3 engineering build (calibrated against CHSRA 2016 Business Plan, SNCF, and UIC benchmarks)

Fixed component dominates

$1,381M of $2,116M (65%) at Regime B is fixed — track maintenance, structures, station ops, OCC, insurance, fleet overhauls. The corridor incurs this whether one rider or eight million ride.

Operations and Maintenance split

Operations (16% of fixed, 65% of variable) covers train crews, energy, rolling stock servicing, stations, G&A — variable-dominated. Maintenance+Fleet (84% of fixed, 35% of variable) covers track, signals, structures, fleet capital and overhauls — fixed-dominated.

Marginal cost ~$90/rider

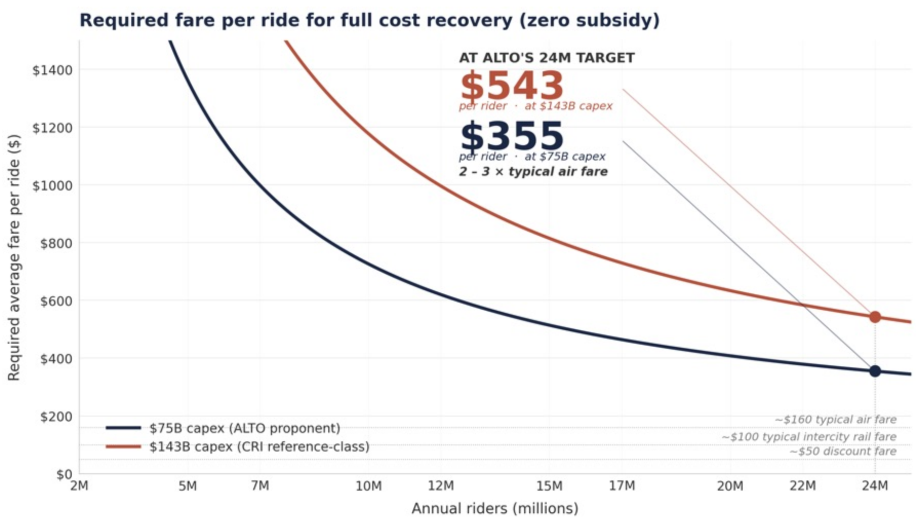
Adding a million riders adds only $89.7M in variable cost — marginal energy, crew hours above baseline, wear-and-tear. The structure makes ridership growth cheap once the fixed cost is borne.

What fare would cost recovery actually require?

Two hypothetical extremes that bracket the real-world choice — no modal-shift assumption applied

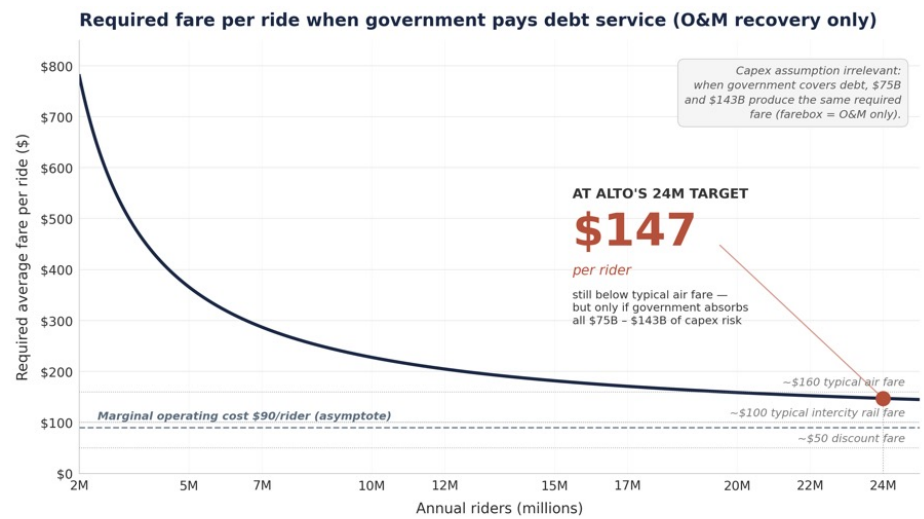
Zero subsidy: farebox covers debt service + O&M

Required fare per ride at full cost recovery, by capex assumption



Government pays debt service: farebox covers O&M only

Capex irrelevant: $75B and $143B collapse to one curve



Self-financing is impossible

At every ridership, the zero-subsidy required fare exceeds typical air fare. At 24M the corridor still needs $355/rider (or $543 at $143B capex) — 2–3× the air-market rate.

O&M alone is achievable, conditionally

If government absorbs capex risk, required fare drops dramatically: $258 at Regime B, $147 at the 24M target. But this assumes ALTO actually achieves these ridership levels.

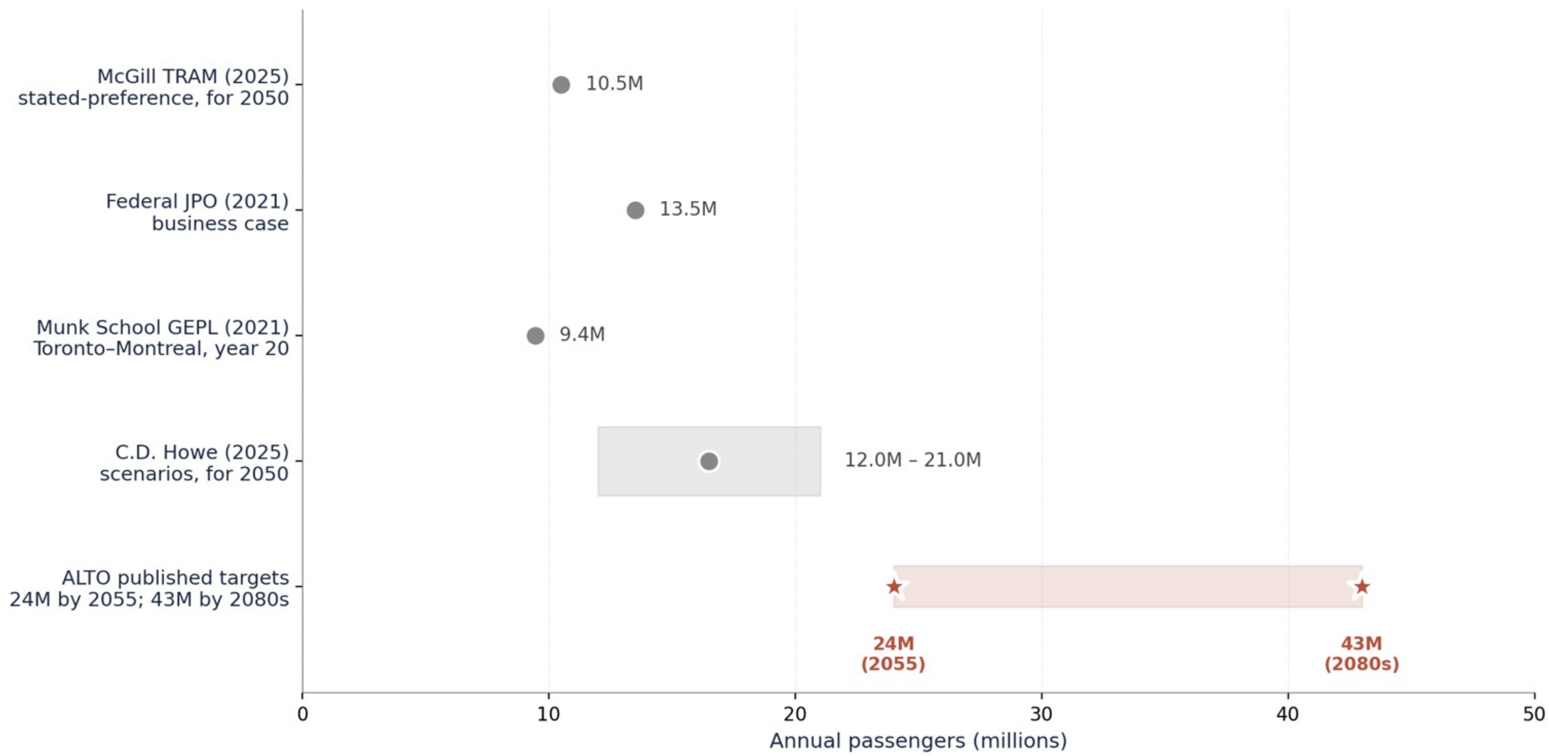
Floor: $90 per rider

Even at infinite ridership the corridor cannot operate on fares below $90, the marginal operating cost from Note 3 ($89.7M per million additional pax).

Hypothetical cost-recovery curves; modal-shift evidence applied separately on next slides

Farebox Revenue: Is 24 million riders realistic?

ALTO's targets compared with four independent estimates for the Toronto–Québec City corridor



The question this deck examines: ALTO's 24M–43M targets sit substantially above every independent estimate. The four notes that follow ask whether the underlying modal-shift, demographic, ridership, and subsidy assumptions can support this gap.

THREE PARALLEL REFERENCE-CLASS AND ENGINEERING INPUTS

STAGE 5

Reference-class modal-shift ridership analysis

Independent ridership envelope, operating-regime structure, and subsidy frontier from air-rail and road-rail S-curves

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Framework underlies Notes 3 and 4 · the next five slides put numbers on each piece

Modal shift versus air follows a logistic S-curve

Note 1 — rail captures the majority of the rail+air market below ~4 hours station-to-station

What the evidence shows

< 2 h — rail dominates (near full capture of rail+air market)

2–4 h — competitive zone (60–80% rail share, infrastructure decisive)

> 5 h — rail share collapses (only price-sensitive or rail-loyal travellers)

Empirical anchors

Paris–Lyon TGV: rail share 40% → 72%

Madrid–Barcelona AVE: ~75% rail share at 2 h 30 min

Madrid–Seville: rail share 16% → 52%

Beijing–Shanghai: 1,318 km in 4 h 18 min, rail-dominant

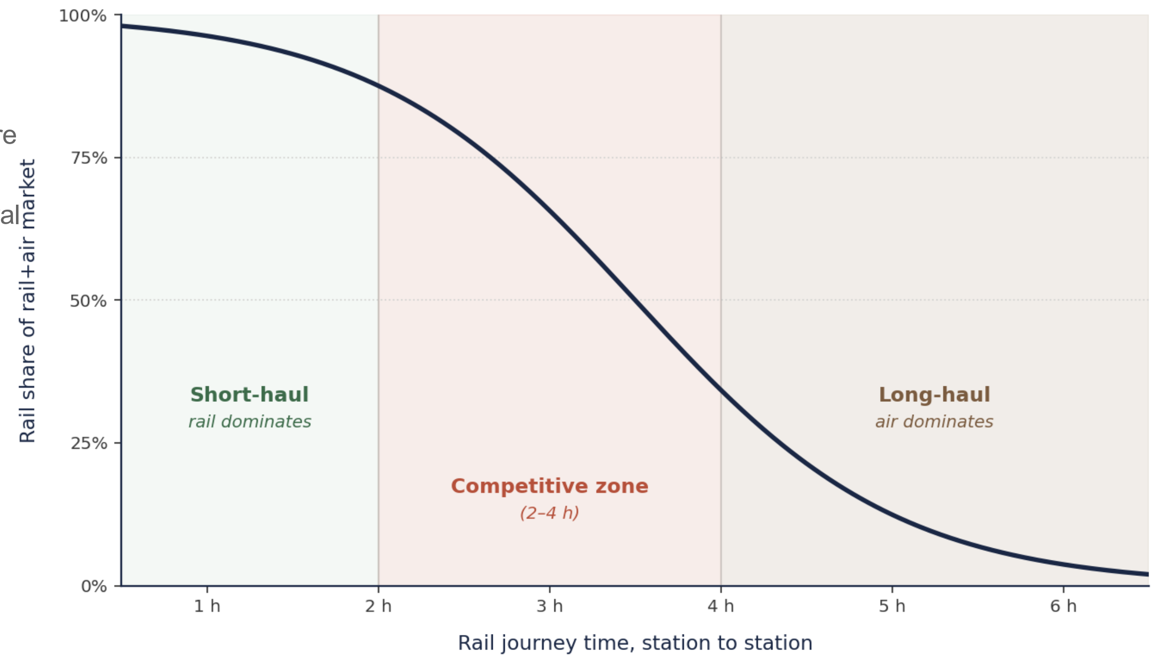


Figure 1 — rail share of the rail+air market, logistic curve with inflection at 3.5 h.

Note 1 · Modal shift between high-speed rail and air on the ALTO corridor

Modal shift versus car: harder in North America

Note 2 — the NA-calibrated S-curve is anchored on VIA Rail's ~13% rail share against road, with a 19-point shift in inflection

Why NA shifts the curve

Toll-free highways — 401/A20 corridor end-to-end

Low fuel taxes — ~1/3 of European levels

No congestion charging anywhere in Canada

Family-car economics — per-person car cost divides among occupants; rail charges per ticket

Predicted rail share of rail+car market

ALTO Toronto–Ottawa (τ ≈ 0.44): **~51% NA / 67% EU**

ALTO Toronto–Montréal (τ ≈ 0.56): **~41% NA / 58% EU**

HPR both pairs (τ ≈ 0.65–0.67): **~33% NA / 50% EU**

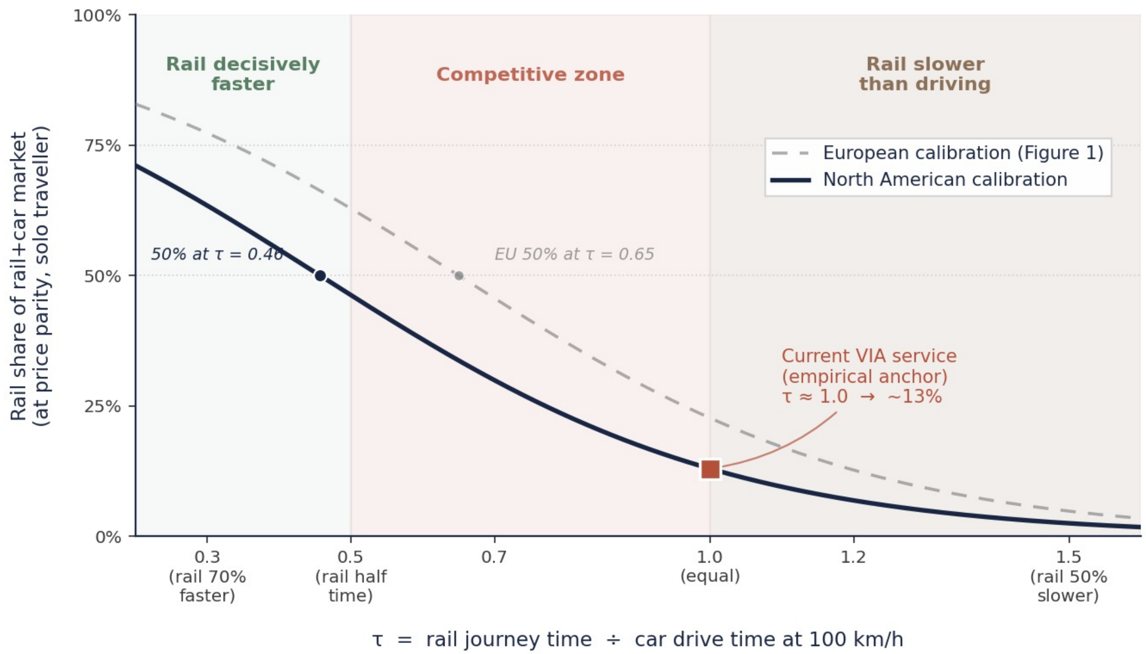


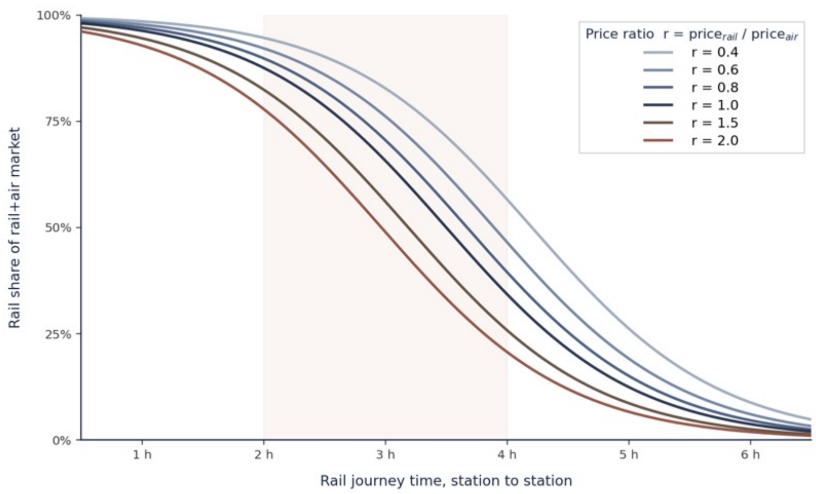
Figure 1b — NA-calibrated rail-vs-car S-curve. Inflection shifts left from τ = 0.65 (Europe) to τ = 0.46 (NA).

Price shifts the whole modal-shift curve

Fare-to-comparator price ratio (r) determines where the corridor sits within each S-curve family

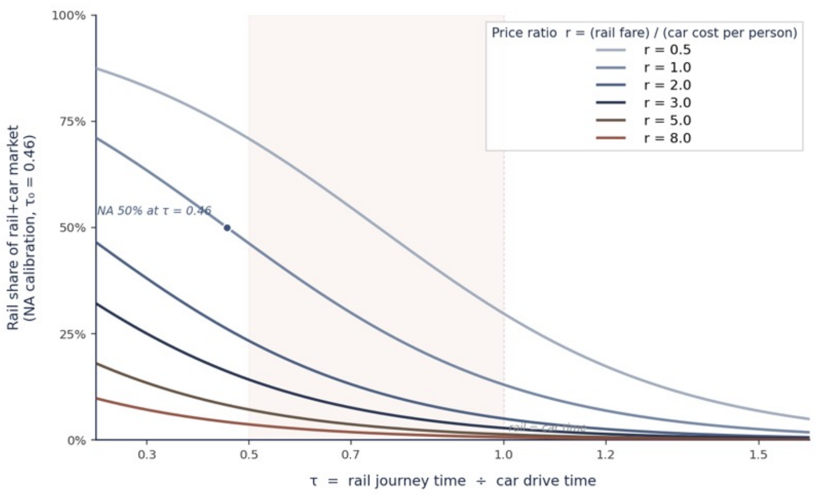
Air-to-Rail

Rail share of the rail+air market vs station-to-station time, at six rail-to-air price ratios.



Road-to-Rail

Rail share of the rail+car market vs τ, at six rail-to-car per-person price ratios.



Price elasticity differs

Road-rail substitution is more price-sensitive than air-rail (γ = 1.5 vs 1.0); families amplify this effect.

Group travel hurts rail

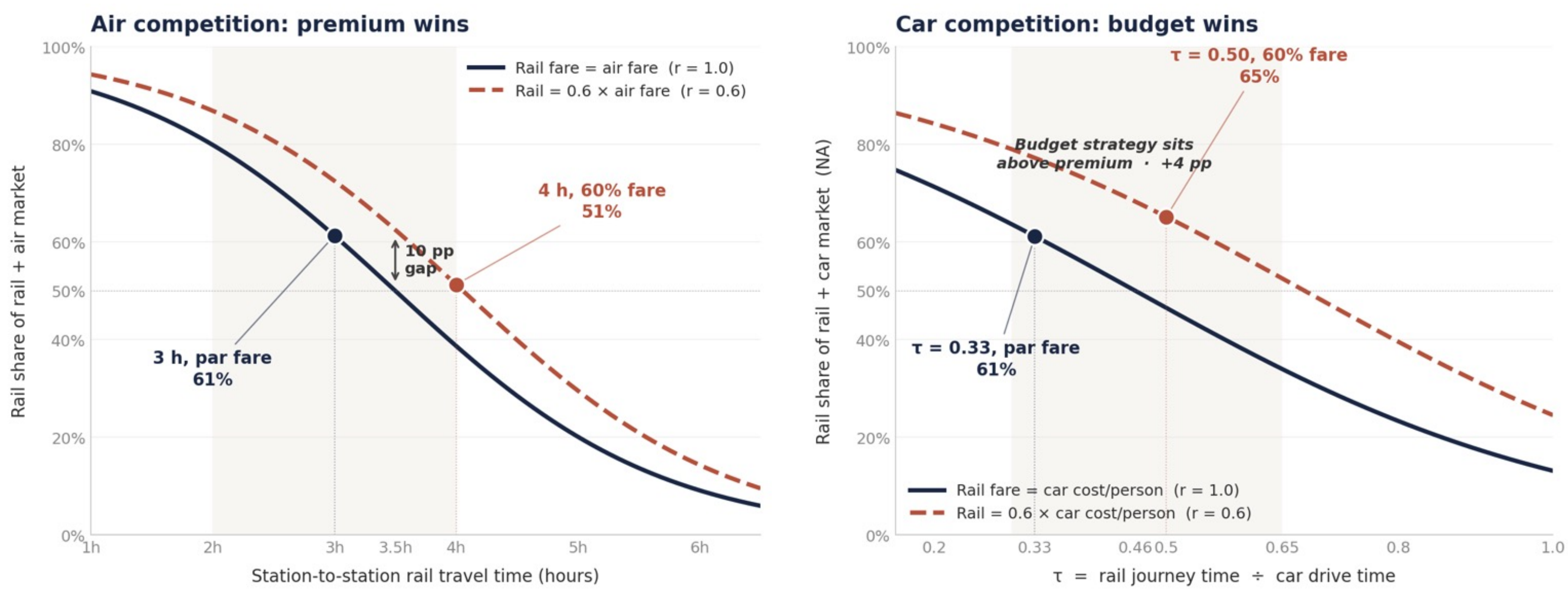
Per-person car cost divides among occupants; rail charges per ticket. A family of 4 faces r 4× higher than solo.

Regime mapping

Regime A r ≈ 0.55 / Regime B r ≈ 1.0 / Regime C r ≈ 1.4 — each selects a different curve in the family.

Modal share: the answer depends on the competitor

Against air, premium speed wins by ~10 pp; against car, budget price wins by ~4 pp



Notes 1 & 2 modal-shift methodology · logistic S-curves, NA calibration for road-rail substitution

Premium strategy

3 h rail at par fare with air, or τ = 0.33 against car. Captures 61% of rail+air and 61% of rail+car market. ALTO design point: 300 km/h dedicated HSR. Wins against air by 10 pp but matches the budget strategy against car.

Budget strategy

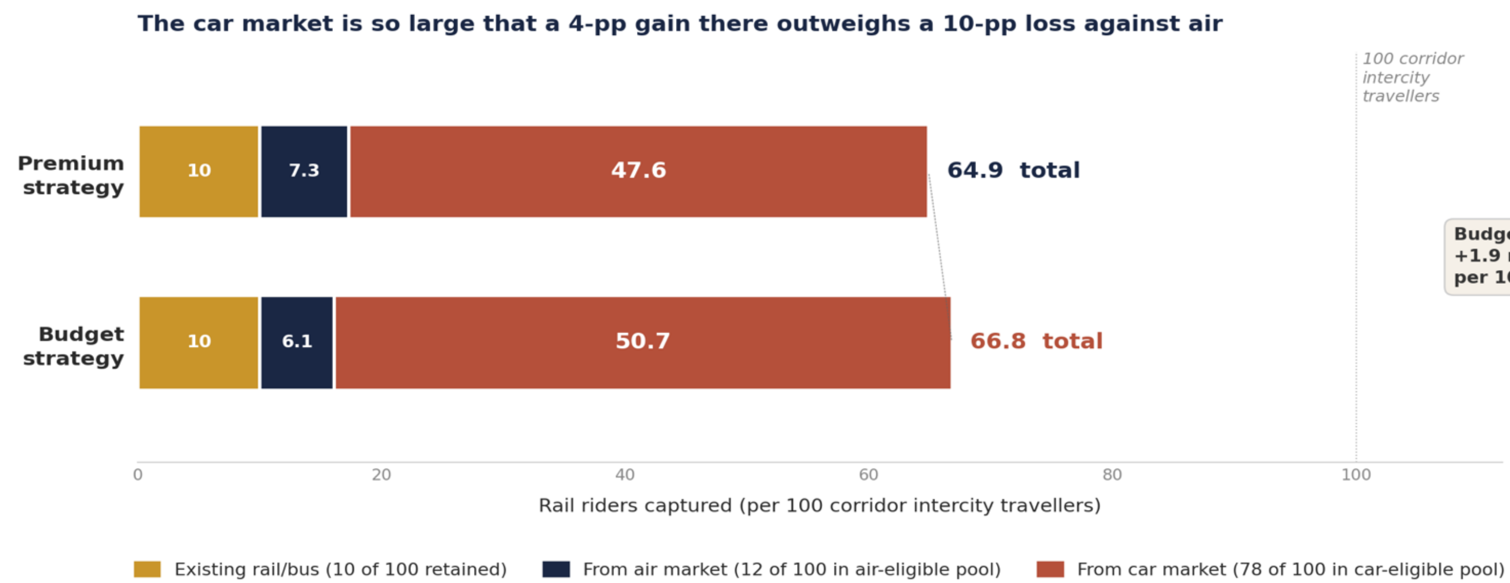
4 h rail at 60% fare, or τ = 0.50 against car. Captures 51% of rail+air and 65% of rail+car market. HPR design point: 200 km/h conventional rail. Loses against air by 10 pp but wins against car by 4 pp.

Net implication

In NA corridors, car is the larger competitor: 70—80% of intercity trips, vs 10—15% by air. The budget strategy wins on the dominant market, loses on the smaller one, and costs ~$114B less in capex. The premium speed premium is hard to justify on modal-share grounds alone.

Absolute ridership: the car market dwarfs the air market

Translating modal-share percentages into riders captured per 100 corridor intercity travellers



NA corridor mode mix: ~78% car, ~12% air, ~10% existing rail/bus · capture rates from Slide 31

Air market is small

Air carries only ~12 of every 100 NA corridor intercity travellers. The premium strategy's 10-pp advantage against air translates to roughly 1.2 additional trips captured per 100. The maximum riders the air market can deliver to rail is ~12; the strategic stakes there are inherently capped.

Car market is dominant

Car carries ~78 of every 100 intercity travellers in NA corridors. The budget strategy's 4-pp advantage against car delivers roughly 3.1 additional trips per 100 — nearly three times the absolute size of the air-market gain that the premium strategy provides.

Net rider capture

Premium captures 64.9 of every 100 corridor intercity travellers; budget captures 66.8. The budget strategy delivers approximately 3% more total riders, at roughly one-fifth the capex. Within the assumptions of Notes 1 and 2, faster-and-pricier is not a stronger ridership strategy than slower-and-cheaper.

The ridership envelope at 2055 is 3.7 to 17.2 million

Note 3 — three demographic trajectories under Regime B (moderate subsidy, fares at parity with air)

9.2M

CRI central case at 2055 (Regime B)

Framework

Ridership = **population** × **per-capita trips** × **modal share** × ramp-up.

Demographic inputs (post-2024)

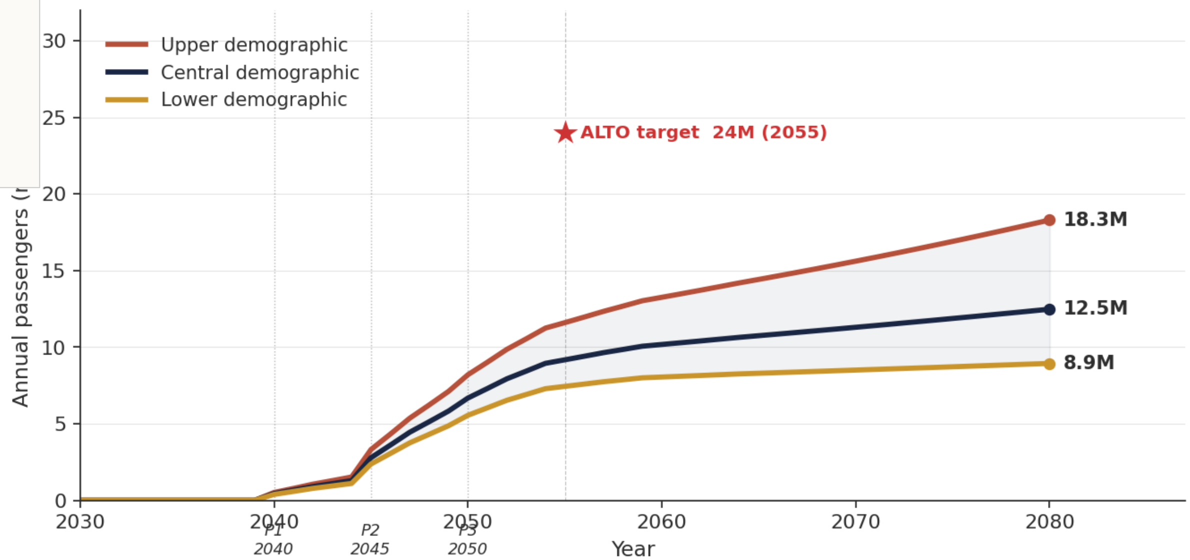
14.9M corridor population (2025)

1.68 intercity trips per resident

StatCan LG / M1 / HG growth: 0.5% / 1.0% / 1.6% per year

Reflects 2024 federal NPR cap

Regime B — moderate subsidy, parity with air

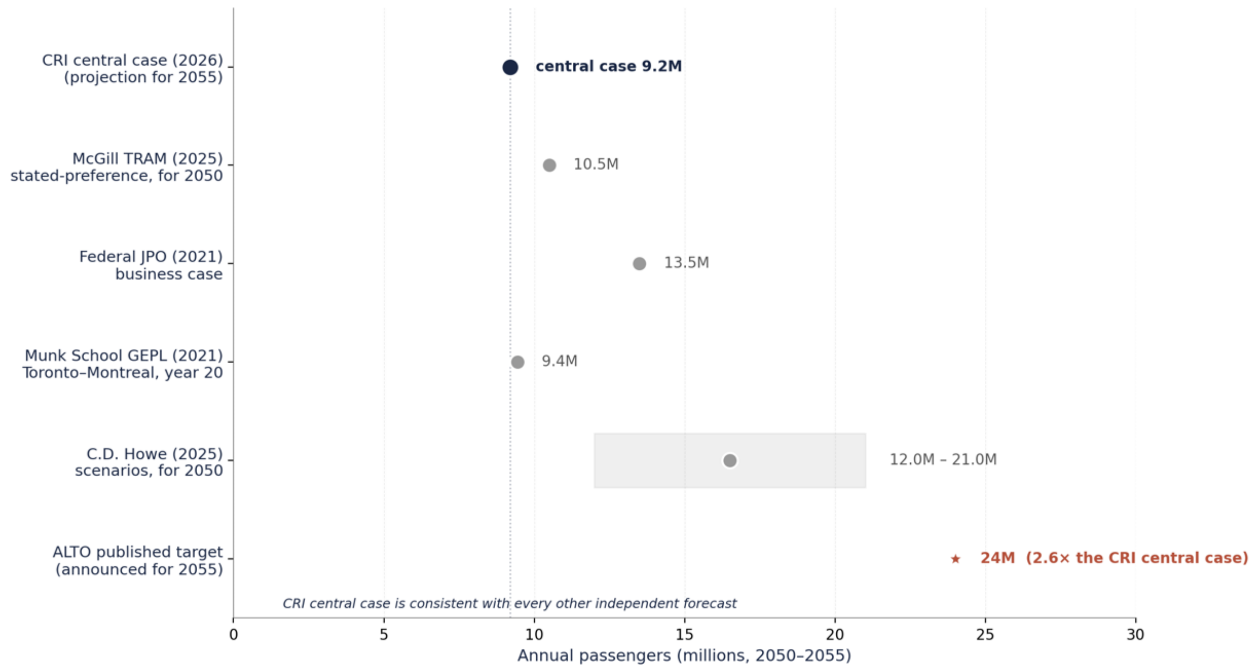


Regime B — central 2055 reading: 9.2M; 2080 reading: 12.5M (central), 8.9–18.3M envelope.

The 24M target is the outlier

Every independent forecast — academic, federal, and policy — clusters around the CRI central case.

CRI central case is reduced by the 2024–25 immigration inflection: the federal cap on non-permanent residents broke the corridor's demographic trajectory, lowering the central forecast relative to pre-2024 expectations.

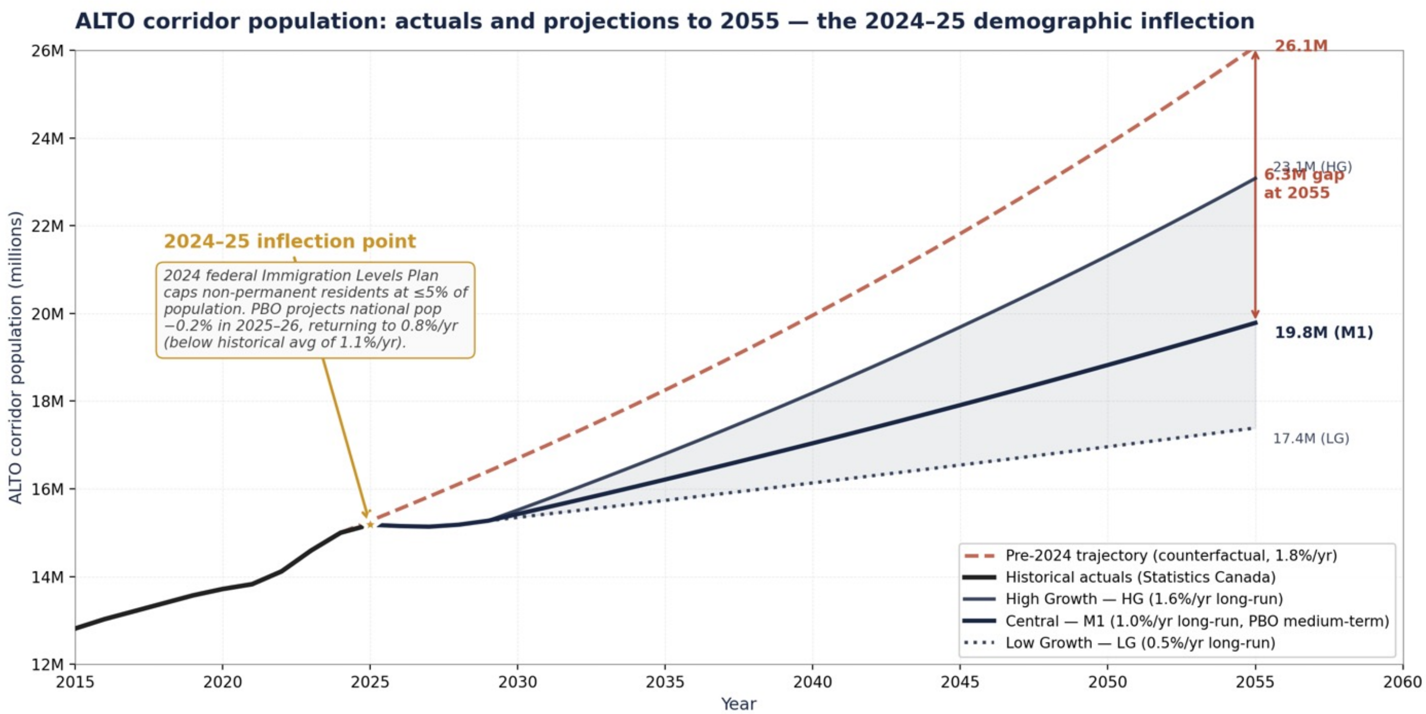


Pre-cap demographics: all independent forecasts — including the 2025 McGill and C.D. Howe studies — use pre-2024 population assumptions; only the CRI analysis incorporates the federal NPR cap.

Post-pandemic business travel: hybrid work and AI-mediated meetings structurally reduce corridor business travel below pre-2020 baseline (Note 3) — a head-wind absent from older forecasts.

Corridor population: the 2024–25 demographic inflection

The federal Immigration Levels Plan broke the surge trajectory — every pre-2024 ridership forecast was built on different demographic assumptions



Structural break, not a fluctuation

The 2024 IRCC plan caps non-permanent residents at ≤5% of population. PBO projects national population shrinks 0.2% in 2025–26, then long-run growth at 0.8%/yr — below the historical 1.1%/yr average.

6.3M fewer people on the corridor at 2055

Central case: 19.8M corridor population vs pre-2024 forecasts of 26.1M. This gap alone reduces the addressable trip pool by roughly 17 million annual trips at 2.6 trips per capita.

Pre-2024 forecasts overestimate ridership

Federal JPO (2021), Munk School GEPL (2021), and McGill TRAM (2025 — still pre-cap demographics) all bake in higher population growth than the post-2024 trajectory supports.

The basic economic framework

Every rail corridor must balance the annual fiscal ledger — the question is who pays for the gap

COSTS — what the corridor must pay each year

REVENUE — where the money comes from

Annual debt service on capital
(capex × CRF)

+

Annual O&M + fleet capital
(operating cost)

=

Annual farebox revenue
(ridership × fare)

+

Public subsidy (federal + provincial)
(closes the gap)

20M taxpayers

Rearranged, the public subsidy is whatever the farebox cannot cover:

Public subsidy = (Debt service + O&M) − Farebox revenue

Each piece is independently anchored

Debt service is set by capex and cost of capital. O&M is set by Note 3 engineering. Revenue is set by ridership times fare. None can be adjusted independently of the others.

Subsidy is whatever closes the gap

The public pays whatever costs exceed farebox revenue. Subsidy is bounded above by total cost (cannot be negative) and below by zero (cannot pay riders to board).

No fare posture eliminates the bill

Raising fares cuts ridership; lowering fares cuts revenue per rider. The next slides show the resulting tradeoff across the achievable ridership range.

Framework underlies Notes 3 and 4 · the next five slides put numbers on each piece

The subsidy frontier under operating-cost-consistent build

Note 4 — operating subsidy bounded by physics (cannot exceed operating cost), capital service dominates

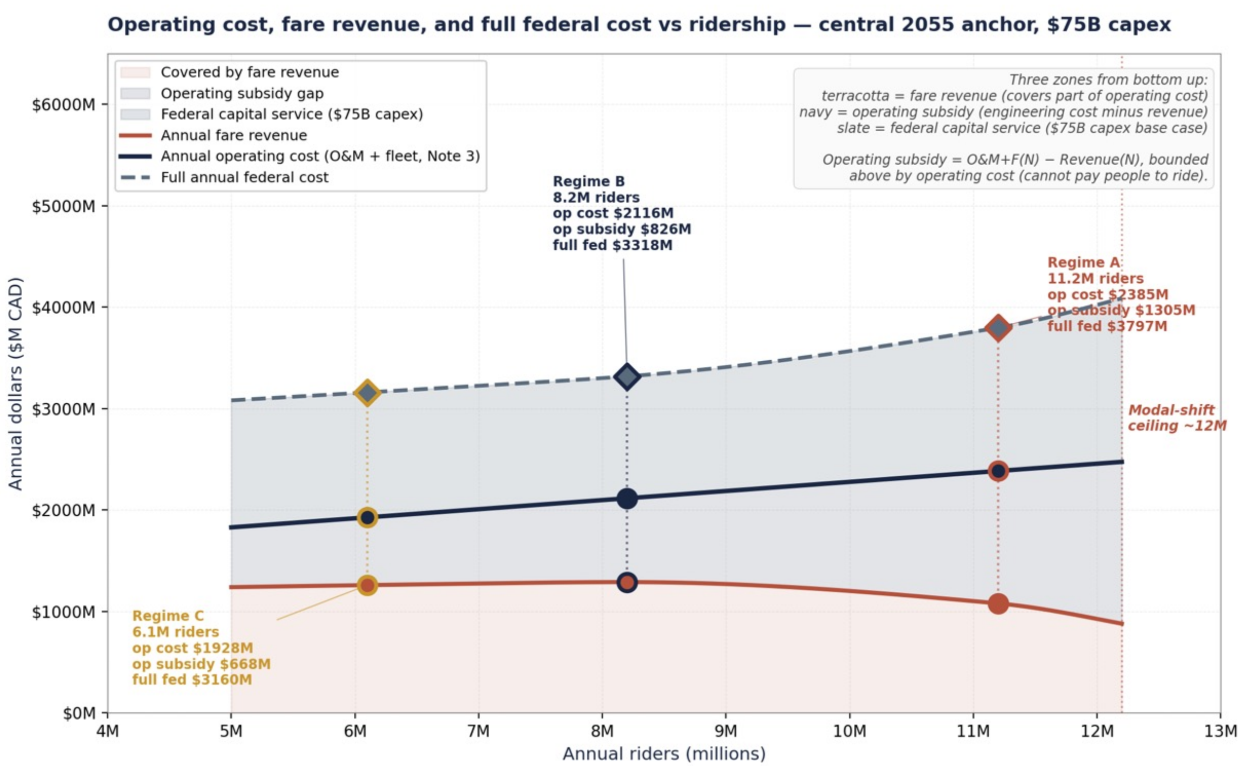


Figure 4 — central 2055 anchor, harmonized $75B capex base case, achievable range only.

What the chart shows

Modal-shift ceiling ~12M

Achievable ridership tops out at ~12M under any fare posture. Operating subsidy rises from $0.67B at Regime C to $1.31B at Regime A across this range.

Capital service dominates

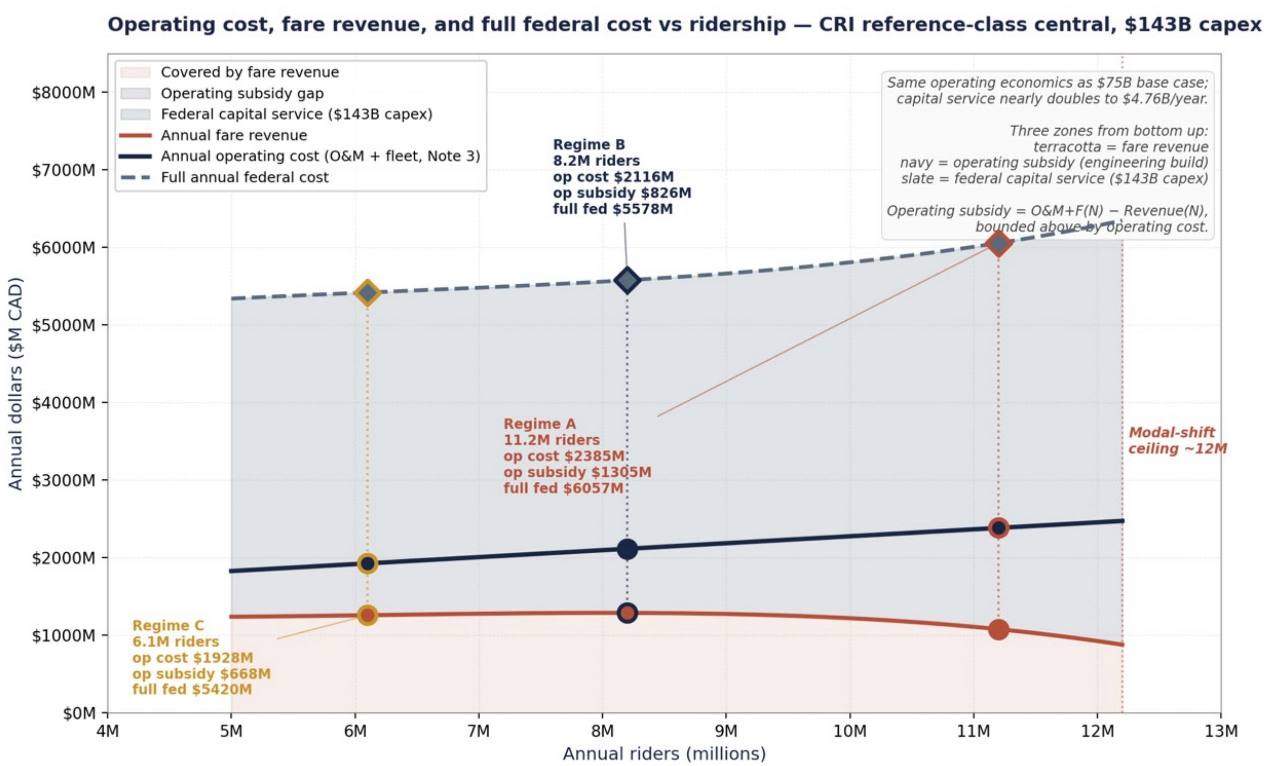
Federal capital service of $2.49B/year is 3–4× the operating subsidy at every regime. Full federal cost: $3.16B at C, $3.32B at B, $3.80B at A.

24M sits off the chart

24M lies twice the modal-shift ceiling. The next two slides examine higher capex ($143B reference-class) and extension to the 24M target.

At $143B capex: full federal cost nearly doubles

Same operating economics, but federal capital service rises to $4.76B/year under the CRI reference-class central capex



Same chart structure as previous slide, CRI reference-class central $143B capex applied.

Note 4 · Subsidy frontier at $143B CRI reference-class central capex

Capex doubles the public bill

Operating economics unchanged

Operating cost and fare revenue are functions of ridership, not capex. Operating subsidy still $0.67B at C, $0.83B at B, $1.31B at A.

Capital service: $4.76B/yr

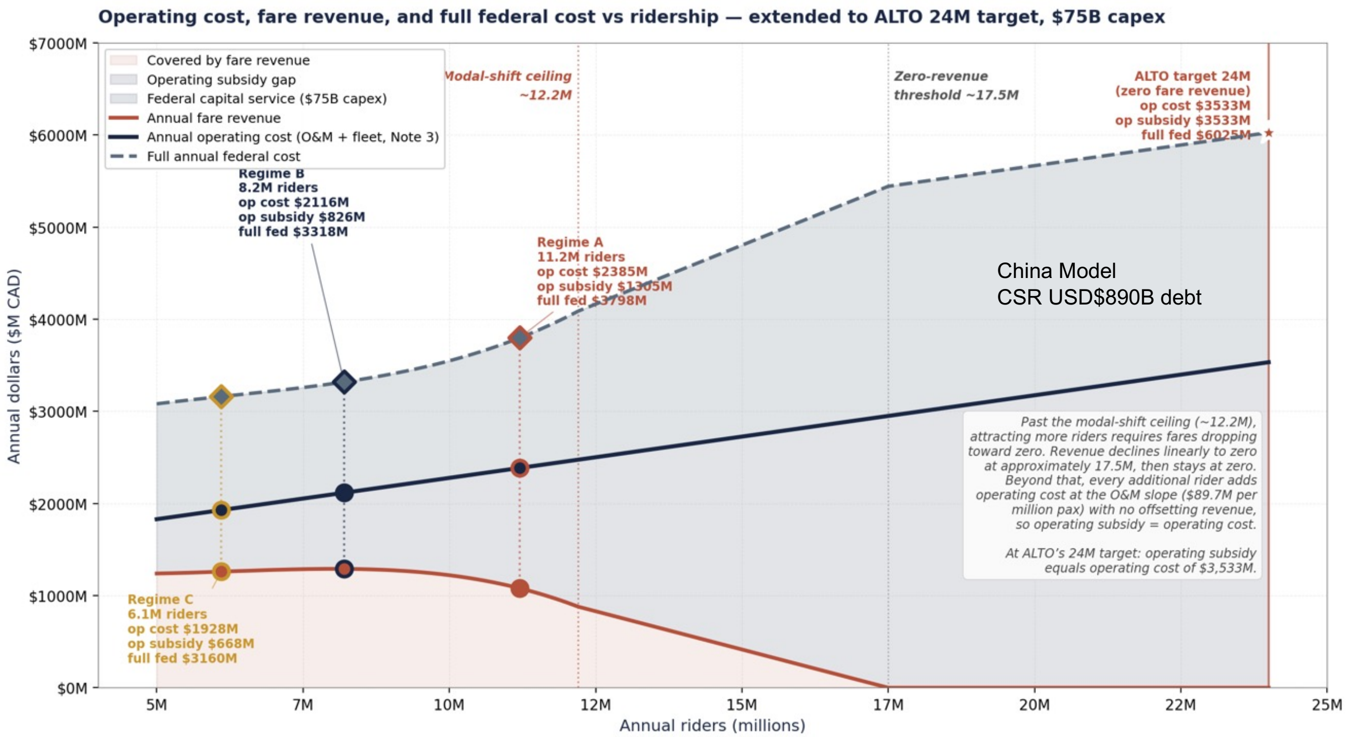
Up from $2.49B at $75B. Capital service now exceeds operating subsidy by 4–7× — the public bill is overwhelmingly driven by capex risk.

Full fed cost: $5.4–$6.1B/yr

Up from $3.16–$3.80B at $75B. The CRI reference-class central is the realistic expected value of capex — ALTO’s $75B sits at the 25th percentile.

Extended to ALTO’s 24M target: fare revenue → zero

Past the modal-shift ceiling, attracting more riders requires fares dropping to zero — then the public pays all operating cost



Extended frontier — revenue declines linearly past 12.2M ceiling to zero at ~17.5M, then flat at zero.

At the 24M target

Zero fare revenue

No fare posture delivers 24M riders without setting average fares to zero. Beyond ~17.5M, every additional rider is carried for free.

$3.5B operating subsidy

With revenue at zero, operating subsidy equals the full Note 3 engineering operating cost: $3.5B/year at 24M ridership.

$6.0B full federal cost

Add $2.49B federal capital service: full federal cost at 24M is $6.0B/year under the proponent’s own $75B capex — nearly double the cost at Regime A.

The basic economic framework

Every rail corridor must balance the annual fiscal ledger — the question is who pays for the gap

COSTS — what the corridor must pay each year

REVENUE — where the money comes from

Annual debt service on capital
(capex × CRF)

+

Annual O&M + fleet capital
(operating cost)

=

Annual farebox revenue
(ridership × fare)

+

Public subsidy (federal + provincial)
(closes the gap)

+

Land value Capture (Annual LVC sstream)
(closes the gap)

CAPEX Debt service + O&M = Farebox revenue + Public subsidy + LVC

Each piece is independently anchored

Debt service is set by capex and cost of capital. O&M is set by Note 3 engineering. Revenue is set by ridership times fare. None can be adjusted independently of the others.

Subsidy is whatever closes the gap

The public pays whatever costs exceed farebox revenue. Subsidy is bounded above by total cost (cannot be negative) and below by zero (cannot pay riders to board).

No fare posture eliminates the bill

Raising fares cuts ridership; lowering fares cuts revenue per rider. The next slides show the resulting tradeoff across the achievable ridership range.

Framework underlies Notes 3 and 4 · the next five slides put numbers on each piece

INTEGRATION AND VERDICT

STAGE 6

NPV and Benefit-Cost Analysis

BCR at three discount rates; iso-BCR analysis of the (ridership, fare) parameter space across three capex scenarios and three operating regimes

From annual ledger to NPV: three perspectives, three mutually reinforcing answers

The same project evaluated from the operator, federal taxpayer, and social cost-benefit views

Project commercial NPV

All nine (regime × capex) combinations strongly negative.

At central capex: −$111B (cluster within $2B).

Regime choice is approximately immaterial at the operator level — capex dominates by two orders of magnitude.

Federal-fiscal NPV

At central capex: −$53B (Regime C) to −$64B (Regime A).

Regime spread of $11B — the federal taxpayer's cost of choosing a higher-ridership regime.

The published business case does not specify which regime the corridor will adopt.

Social cost-benefit NPV

At central capex: −$108B to −$110B (essentially flat).

BCR 0.07–0.09 — far below 1.0 and below JPO 2021 HFR's already sub-viability ~0.40.

Welfare-efficient frontier neutralises the regime choice.

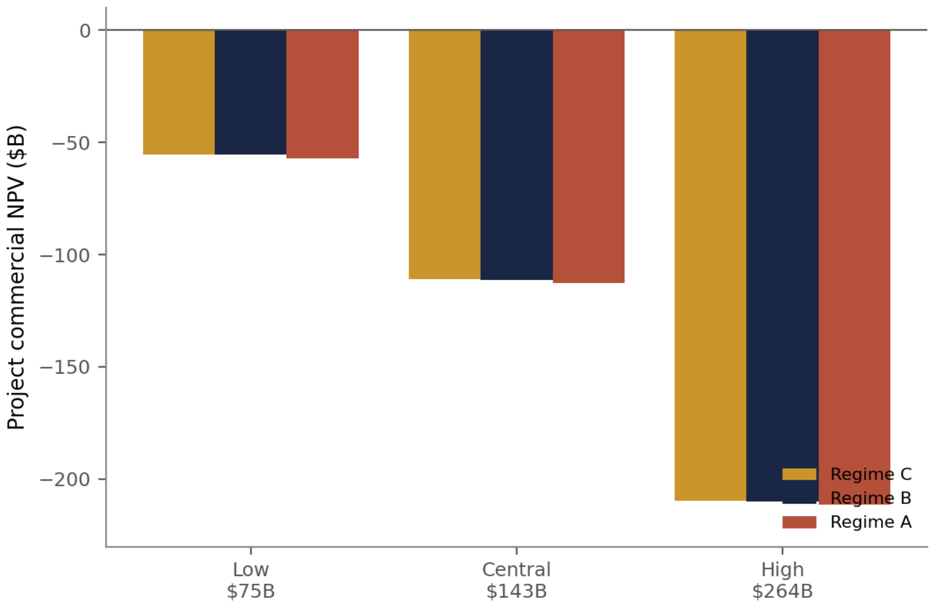
The synthesis:

All three perspectives reach the same conclusion — ALTO destroys substantial economic value under every defensible parameterisation. The perspectives differ only in who pays.

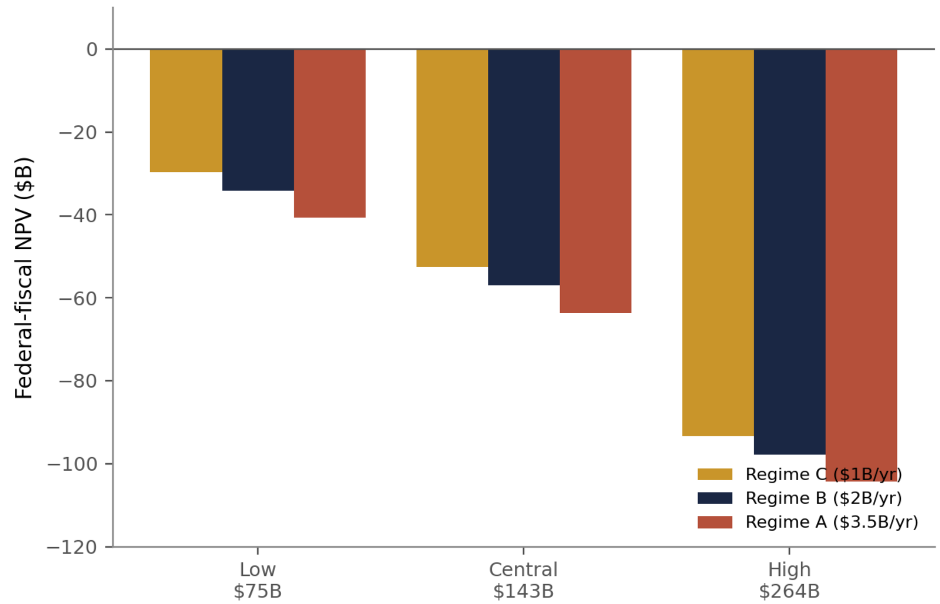
Capex dominates the operator; regime matters federally

Two perspectives on the same project — all values in CAD billions, real 2029$, 8% TBS Central

Project commercial NPV — regime barely matters



Federal-fiscal NPV — regime is an $11B decision



The contrast:

From the operator's view, regime choice is a ~$2B decision because capex dominates. From the federal taxpayer's view, the same choice is an $11B decision — reflecting the opera
subsidy ladder.

Social BCR is 0.04–0.17 across the matrix — far below the 1.0 viability threshold

Adding economic externalities to project cash flows does not change the structural finding

Social BCR — central-capex cluster is 0.07–0.09

	Low $75B	Central $143B	High $264B
Regime C	0.14	0.07	0.04
Regime B	0.16	0.08	0.05
Regime A	0.17	0.09	0.05

Reference values

1.0

viability threshold

0.40

JPO 2021 HFR
(already sub-viability)

The McGill TRAM $12B land value capture is a placeholder, not a forecast

Reverse-engineered from a 15% rule of thumb to make the financing equation close

What the McGill TRAM model assumes

$12B LVC asserted as ~15% of $79.8B capex, reverse-engineered to bring borrowed principal down to a 'manageable' $41.2B.

The model contains no parcel-level valuation, no station-area market analysis, no comparable transaction work, and no DCF of expected development revenues.

A different capex assumption changes the LVC number arithmetically — without any change to underlying property economics.

What international comparators support

HS1 in the UK, Crossrail's Business Rate Supplement, Hong Kong's MTR Rail+Property model, and Japanese private-railway joint development arrangements typically fund 5–15% of capital service requirements through LVC — not capital cost.

Translated to ALTO's Canadian institutional context, a defensible figure for PV of plausible station-area capture is in the low single billions — well under 5% of capital cost.

Why it matters: Without the $12B placeholder, the McGill TRAM model's borrowed principal rises from $41.2B to ~$53B, and the project never reaches self-sufficiency by Year 50. The LVC line is structurally load-bearing in the proponent case.

INTEGRATION AND VERDICT

STAGE 7

Institutional review (QA1 / QA2)

Pass/fail assessment against the eight Norwegian QA1 criteria and six QA2 forward-assessment criteria — and the case for an independent PBO review

The Norway QA System — How It Works

Mandatory two-gate external review under the Ministry of Finance, in place since 2000 for all major public investment projects.

1. CONCEPT — *appraisal (KVU document)* → **QA1** — *concept review* → **2. PRE-PROJECT** — *detailed design* → **QA2** — *cost & management review* → **3. PARLIAMENT** — *funding vote (Storting)*

QA1 EXAMINES

- Needs, goals, and requirements
- Alternatives (zero + ≥ 2 concepts)
- Cost-benefit and cost estimation
- Risk and distributional alignment

→ ***Recommendation to Cabinet***

QA2 EXAMINES

- Stochastic cost frame at P85
- Reduction list (kuttliste)
- Management challenge assessment
- Updated CBA + risk register

→ ***Parliamentary cost frame***

≥ NOK 1B

MANDATORY THRESHOLD

≈ CAD 130M; petroleum sector exempt

MoF picks

REVIEWER SELECTION

From a pre-approved consortia framework, not by proponent

≈ 75%

ON-BUDGET DELIVERY

Post-QA2 projects, vs 59–183% pre-QA overruns

Governing circular: R-108/23 (R-108/25) · Concept Research Programme, NTNU

QA1 Verdict — Concept-Stage Review

5 FAIL | 2 PARTIAL | 1 COND. PASS

No unconditional pass on any of the eight criteria.

01	**Needs analysis**	COND. PASS	Real problems, but not specific to a 300 km/h HSR-class solution
02	**Goals and objectives**	PARTIAL	Stated but not quantified; not differentiated from HFR or HPR
03	**Requirements analysis**	PARTIAL	Engineering envelope partial; cold-climate operations not addressed
04	**Alternatives analysis**	FAIL	No structured ALTO / HFR / HPR comparison published
05	**Cost-benefit analysis**	FAIL	Central BCR 0.11; max defensible 0.44 — below Ontario's 0.70 threshold
06	**Cost-estimate methodology**	FAIL	Deterministic $75B point estimate; no reference-class or stochastic frame
07	**Risk and uncertainty disclosure**	FAIL	No public risk register; ECI 73/100 and CFI 65 untreated
08	**Distributional and societal alignment**	FAIL	No distributional analysis; consultation not nation-to-nation on concept

Sources: ALTO_NPV_Research_Report · ALTO_IsoBCR_Research_Note · ALTO_NPV_Analysis_v3

QA2 Verdict — Pre-Funding Forward Assessment

5 FAIL **1 PARTIAL** *Financial findings deepen rather than improve at pre-funding stage.*

01	**Stochastic cost frame at P85**	FAIL	Implied P85 ≈ $185B vs published $75B (≈ 2.5×)
02	**Reduction list (kuttliste)**	FAIL	300 km/h dedicated greenfield largely indivisible
03	**Management challenge assessment**	FAIL	ECI 73/100 and CFI 65 unaddressed in proponent material
04	**Updated CBA with benefit realisation**	FAIL	NPV −$102B central; 9-cell grid −$55B to −$187B at 8% TBS
05	**Project management base**	PARTIAL	Cadence consortium named; risk-sharing and capital split TBD
06	**QA1 compliance**	FAIL	Procedurally moot — ALTO does not pass QA1

Under Norwegian rules QA2 follows QA1 sequentially; this is a forward assessment for completeness

THE VERDICT

The 24-million target fails three independent feasibility tests

1

Modal-shift framework

Reaching 24M requires modal share above the 40 per cent ceiling implied by the NA-calibrated S-curves in Notes 1 and 2. Even ALTO's heaviest-subsidy regime, with deeply discounted fares, plateaus near 11–12M annual riders at the modal-shift ceiling.

2

Demographic baseline

The 2024 federal Immigration Levels Plan capped non-permanent residents, producing a structural break in corridor population growth. Pre-2024 forecasts assumed continued surge; post-2024 trajectories are materially lower. 15–25 per cent of the gap to ALTO is demographic alone.

3

Subsidy frontier

At ALTO's 24M target, fare revenue collapses to zero and operating subsidy equals operating cost ($3.5B/year). Adding federal capital service of $2.5B/year on the proponent's own $75B capex brings full federal cost to approximately $6.0B/year — nearly double the cost at Regime A.

CONCLUSIONS · ALTO vs HPR

ALTO costs five times more than HPR

The predicted cost gap is roughly half engineering, half community friction — not a function of timing

ALTO predicted cost

$142 B

central · +/- 2SD $76 – 264 B · over 1,000 km

EClw = 77 · CFI = 65

HPR (200km/h 401 Corridor) predicted cost

$28 B

central · 95 % PI $15 – 54 B · over 1,000 km

EClw = 45 · CFI = 30

Decomposition of the 5.0× cost gap

Engineering complexity (ΔEClw = 32)

Community friction (ΔCFI = 35)

RECOMMENDATION

An independent PBO review is warranted

before any final ALTO corridor selection decision is reached

The specific PBO request

"Conduct an independent benefit-cost analysis of the ALTO high-speed rail project using the methodology summarised in this document, and report findings to Parliament before the federal corridor selection decision is finalised."