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The Public Health and Societal Consequences of Glasgow VLR Line 1 & 2 Not Going Ahead

September 2025

Pre-Feasibility Report: The Public Health and Societal Consequences of

Glasgow VLR Line 1 (East – West)

Not Going Ahead,

(with or without Hydrogen)

Summary

The proposal for Glasgow Line 1, an East-West, (Hydrogen) Very Light Rail (VLR) either using

H2 over Fuel Cell Battery onboard transit line, or by OHLE Wire is positioned as a transformative upgrade to Glasgow's urban mobility network, aiming to deliver major health, air quality, and equity benefits by shifting significant trips from high-pollution car journeys to zero-emission rail modes and is seen as one of two lines omitted from the Clyde metro plans.

Commissioned and funded independently by Triton Hydrogen Ltd and Light Rail UK, and Associates.

This prefeasibility report explores the public health and societal costs—across mortality, morbidity, illness rates, and economic value—of failing to implement the project. By integrating the latest UK-wide and Glasgow-specific air quality, public health, and transport data, and following current Department for Transport (DfT) and HM Treasury guidance on health impact valuation, the report provides a robust analytical foundation to highlight the consequences of "doing nothing" and maintaining business-as-usual transport patterns.

Key findings suggest that if the modal shift is not achieved, Glasgow will continue to experience a disproportionate burden of mortality and morbidity due to air pollution and transport-related inactivity. These impacts are not only measured in premature deaths and increased instances of chronic disease but also in billions of pounds in economic costs to the healthcare system, lost productivity, and reduced quality of life.

Modal shift benefits, otherwise achievable through Line 1, would substantially reduce this burden. The evidence presented underscores the high public health and economic price of inaction.

This is a

Joined up thinking and not a

Transport in a silo

Pre-feasibility study

1. What is Very Light Rail

VLR stands for **Very Light Rail** — a new generation of **urban and regional tram-scale systems** designed to deliver the benefits of rail at a fraction of the cost and complexity of traditional light-rail or metro. Here's a concise technical overview:

Core Concept

- **Very Light Rail** uses **lightweight modular vehicles** and **shallow-build trackform**, typically 300–500 mm deep, allowing installation in existing streets without major utility diversions.
- It's engineered for **medium-capacity corridors** (around 100 passengers per unit) and **turn-up-and-go reliability**.

Key Characteristics

Feature	Description
Vehicle mass	~20–25 tonnes per car — roughly half that of a conventional tram
Trackform	Prefabricated slab or embedded rail, minimal excavation
Power	Battery, hydrogen, or hybrid electric — no continuous overhead line
Speed range	40–70 km/h urban, up to 90 km/h inter-urban
Accessibility	Level boarding, 350 mm sill height, compliant with inclusive design
Capital cost	£12–25 million per km (vs £40–120 million for light-rail)

Policy Alignment

VLR supports:

- **NPF4** – place-based regeneration and 20-minute neighbourhoods
- **STPR2** – low-carbon mobility and modal shift
- **Cleaner Air for Scotland** – reducing non-exhaust emissions
- **Just Transition** – affordable, equitable access to clean transport

Use Cases

- Urban connectors and regeneration corridors
- Feeder routes to heavy-rail or metro systems
- Shuttle operations in constrained city centres
- Demonstrator projects (e.g. Coventry VLR, Cambridge Connect)

System Comparison Overview

This simple **schematic comparison** showing how **Very Light Rail (VLR)** differs from a **conventional tram** in engineering, cost, and urban impact. This is a conceptual overview — not a manufacturer drawing — designed for clarity in ministerial or stakeholder briefings.

Parameter	Very Light Rail	Conventional Tram
Vehicle mass	~20–25 tonnes per car	~40–55 tonnes per car
Track depth	300–500 mm shallow slab	800–1200 mm deep excavation
Utilities diversion	Minimal (track sits above utilities)	Extensive (utilities relocated)
Power system	Battery or hydrogen (no overhead wires)	Continuous overhead catenary
Capital cost	£12–25 million per km	£40–120 million per km
Delivery time	5–7 years	15–25 years
Street integration	Embedded in existing carriageway	Requires full reconstruction
Noise & vibration	Low (rubber isolation, low mass)	Moderate (steel-on-steel, heavier bogies)
Accessibility	Level boarding, 350 mm sill height	Level boarding, 300–350 mm sill height
Energy use	0.6–0.8 kWh per vehicle-km	1.2–1.8 kWh per vehicle-km
Maintenance	Modular slab replacement	Full track renewal every 20 years
Urban disruption	Low	High

Visual Summary

- **VLR:** lightweight modular track panels, battery or hydrogen propulsion, minimal civil works.
- **Tram:** heavier vehicles, deep trackform, overhead power, major street reconstruction.
- **Result:** VLR delivers **tram-like capacity and permanence** at roughly **one-third the cost** and with **one-quarter the disruption**.

Origins and Context

- **Post-Edinburgh fallout:** The Edinburgh tram overspend (2008–2011) created political and fiscal shockwaves. Ministers needed a demonstrably cheaper, faster, and less disruptive model.
- **Norman Baker's initiative:** He backed a series of **"ultra-light" demonstrators** — small, modular vehicles and shallow trackforms — to test whether rail permanence could be achieved at bus-level cost.
- **Prototype lineage:** Early systems included **Parry People Mover**, **ULR Group**, and **TIG/m Via Tran** concepts, each exploring lightweight bodies, regenerative braking, and non-overhead power.

Technical Philosophy

- **Low mass:** Typically, under 25 tonnes per car.
- **Shallow trackform:** 350–500 mm slab depth, avoiding utility diversions.
- **Modular construction:** Prefabricated panels for rapid installation.
- **Alternative propulsion:** Battery, hydrogen, or hybrid electric — no continuous catenary.
- **Urban compatibility:** Designed for constrained corridors and heritage streets.

Policy Impact

The VLR concept became the **foundation for Coventry VLR**, **Cambridge Connect**, and **Milton Keynes VLR** projects, each proving that rail permanence and low-carbon operation could coexist with realistic municipal budgets.

It also reframed the debate: from "Can we afford rail?" to "Can we afford not to?" — given the air-quality and regeneration benefits.

The Black Country Innovative Manufacturing Organisation (BCIMO)

Demonstrator track at Dudley proved that VLR could use a **standard rail section** in a **shallow concrete slab** while still coping with the **axle loadings of modern LRVs**.

Key features:

- **Hardened concrete formulation** with high compressive strength and fibre reinforcement.
- **Standard tram rail (grooved or flat-bottom)** embedded directly into the slab.
- **Depth:** typically, **350–400 mm**, allowing installation above utilities.
- **Axle-load capacity:** verified for **Stadler, CAF, and Bombardier LRV classes**.
- **Construction speed:** modular panels enable **rapid installation and curing**, reducing disruption to days rather than months.
- **15 metre curves**

Tritonor Ultra-Hard Concrete Base

Triton Hydrogen Ltd, **Tritonor system** pushes this further:

- **Extra-hard concrete base (< 400 mm)** capable of supporting **TramTrain vehicles** such as the **Stadler Citylink** in street-running mode.
- **High-density aggregate and polymer admixtures** provide exceptional fatigue resistance.
- **Short construction times:** prefabricated sections and fast-curing concrete allow installation in **under 48 hours per segment**.
- **Compatibility:** standard rail profiles, conventional wheelsets, and embedded drainage channels.

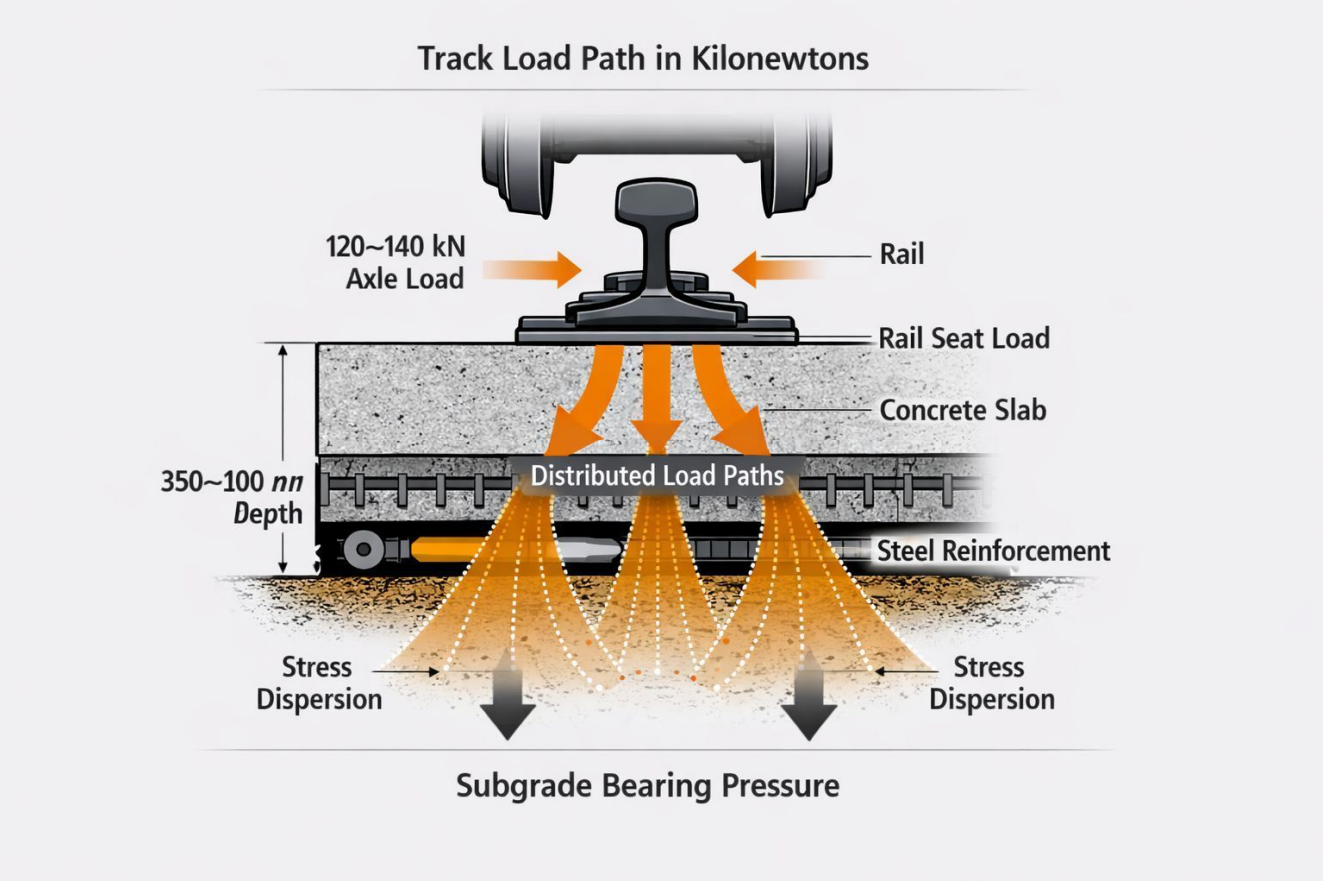
Engineering Implications

Parameter	BCIMO Shallow Track	Tritonor Ultra-Hard Base
Depth	350–400 mm	< 400 mm
Rail Type	Standard tram rail	Standard tram rail
Axle Load Capacity	Modern LRV (up to 12 t/axle)	TramTrain (up to 14 t/axle)
Concrete Type	Fibre-reinforced UHPC	Polymer-enhanced UHPC
Construction Time	3–5 days per section	1–2 days per section
Applications	Urban VLR, regeneration corridors	TramTrain, mixed-traffic streets

Why It Matters

This generation of shallow-track technology **closes the gap** between VLR and full tram systems:

- Enables **street-running of heavier vehicles** without deep excavation.
- Reduces **programme risk and cost**.
- Supports **rapid deployment** for regeneration and air-quality corridors.
- Demonstrates **UK-developed innovation** with export potential.



BCIMO & Tritonor track cross-section shallow track

Fibre-reinforced concrete, standard rail, 350–400 mm depth, utilities directly beneath, steel mesh reinforcement.

Tritonor ultra-hard base Polymer-enhanced UHPC, high-strength reinforcement, < 400 mm depth, engineered for **TramTrain axle loads**, standard rail profile.

2. The Emergence of Affordable Light Rail for Britain's Cities

"Britain is once again redefining the economics of urban rail."

In the wake of the **Edinburgh Tram Phase 1 overspend**, the Department for Transport initiated a decisive shift in policy — led by **Minister Norman Baker** — to prove that rail permanence could be delivered **without the heavy civil engineering** that had long constrained city budgets. From that moment, the term **Very Light Rail (VLR)** was born: a commitment to **low-cost, low-impact, high-performance urban mobility**.

Engineering Breakthroughs

- **BCIMO Shallow-Track System** — a fibre-reinforced concrete slab of just 350–400 mm depth, embedding **standard rail** and coping with **modern LRV axle loadings**.
- **Tritonor Ultra-Hard Base** — polymer-enhanced UHPC of < 400 mm depth, capable of supporting **Stadler TramTrain vehicles** in street-running mode.
- Both systems deliver **short construction times**, **minimal utility disturbance**, and **full compatibility with existing tram standards**.

These advances transform light rail from a major-works project into a **repeatable urban intervention** — deployable in weeks, not years.

3. Urban Fit: Glasgow as the Model

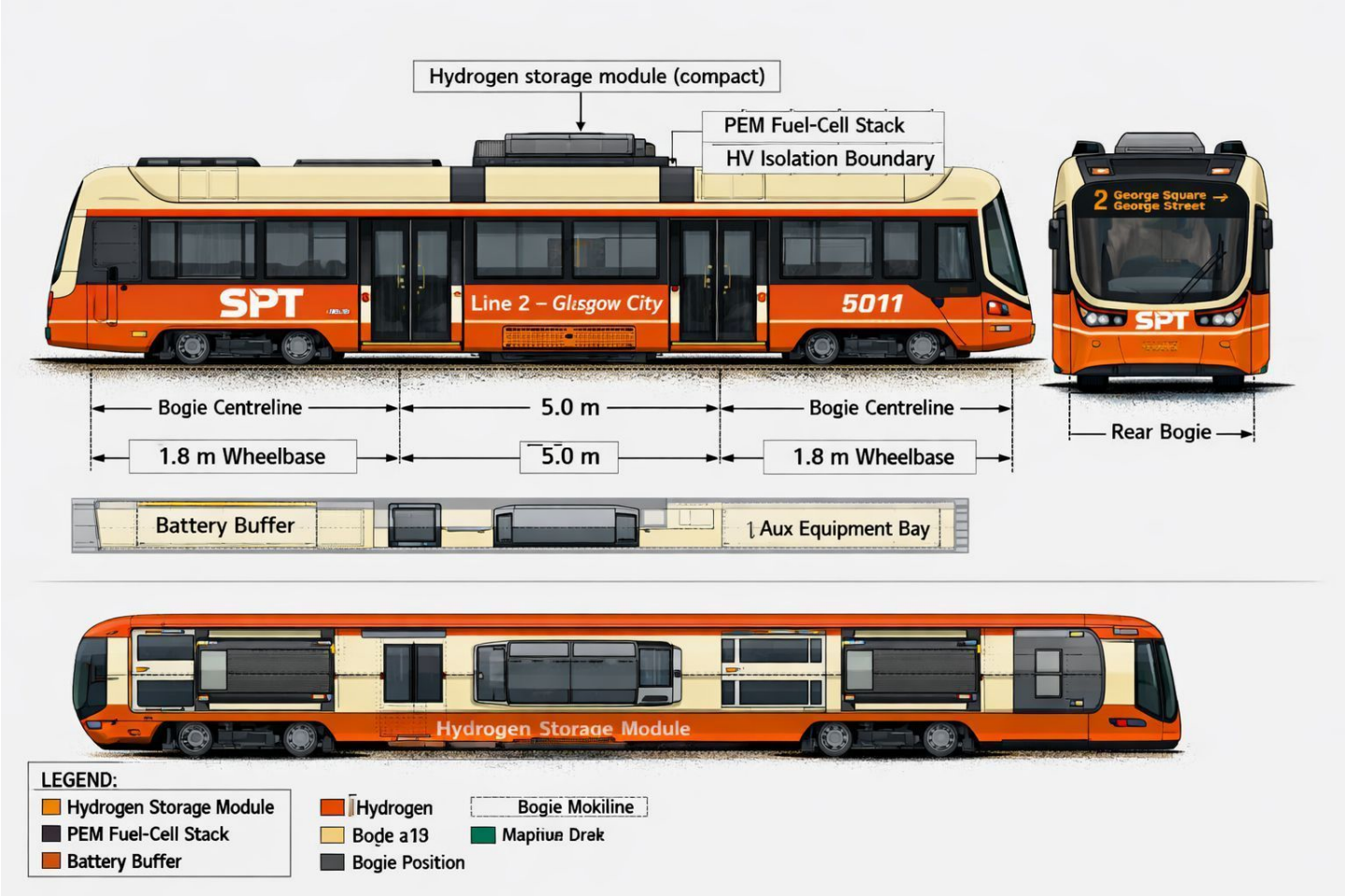
Few cities illustrate the opportunity better than **Glasgow**. Its **grid-pattern centre**, **broad radial corridors**, and **heritage of double-bogie tram routes — Lines 1 and 2 in particular —** embody the geometry and service philosophy that VLR was designed for. Where "classic rail consultants" still struggle to reconcile cost, geometry, and accessibility, VLR fits naturally:

- **Shallow-build track** aligns with Glasgow's existing street gradients.
- **Modular construction** supports incremental rollout across districts.
- **Modern MRV-scale vehicles** restore the frequency and visibility once described as *"a tram always in sight."*

Policy Significance

This is not a niche innovation — it is a **national affordability revolution**. By combining **British concrete technology**, **standard rail engineering**, and **modular urban design**, VLR offers a **credible pathway to zero-emission mass transit** for every UK city-region.

"The era of affordable light rail has arrived — and it began here, in Britain."



TMK 2400 from **Končar – Električna Vozila (Zagreb)**

Definition

In concrete engineering, kilonewtons (kN) are the standard unit for measuring force or load, especially when referring to compressive strength, axle loads, and structural capacity.**1 kilonewton (kN)** equals **1,000 newtons (N)**.

- A **newton** is the force required to accelerate **1 kilogram** of mass at **1 metre per second squared.**
- In practical terms, **1 kN ≈ 100 kgf** (kilograms-force).

So, when a concrete slab is rated for **250 kN/m²**, it means it can safely resist a **distributed load equivalent to 25 tonnes per square metre**.

Application in VLR Track Construction

Parameter	Typical Value	Description
Compressive strength	60–120 MPa (≈ 60,000–120,000 kN/m²)	Resistance of concrete to crushing under load
Axle loading	100–140 kN per axle	Typical for modern LRVs and TramTrains
Shear capacity	30–50 kN/m	Resistance to lateral forces from wheel-rail contact
Bond strength (rail embedment)	10–20 kN/m	Adhesion between rail and concrete matrix

Why It Matters

Using kilonewtons allows engineers to:

- Compare **vehicle axle loads** directly with **track capacity.**
- Design reinforcement and UHPC mixes to meet **specific load paths.**
- Ensure **fatigue resistance** under repeated dynamic loads from LRVs and TramTrains.

In the **BCIMO shallow-track** and **Tritonor ultra-hard base**, the concrete formulations are engineered to withstand **> 140 kN per axle**, ensuring compatibility with **Stadler TramTrain** and other heavy urban vehicles.

4. Briefing Note: Affordable Light Rail – Britain's Urban Transport Revolution

Purpose

To inform civic leaders, councillors, and advisers of the transformative potential of **Very Light Rail (VLR)** — a British innovation that delivers the permanence and quality of tram systems at a fraction of the cost and disruption.

Background

Following the overspend on Edinburgh Tram Phase 1, the Department for Transport initiated a new programme under Minister Norman Baker to develop **low-cost, low-impact rail technology**. This led to the creation of VLR — a system designed to bring rail back to cities without the heavy civil engineering that previously made trams unaffordable.

The Innovation

At the heart of VLR lies a **shallow-build trackform**, developed by **BCIMO** and refined by **Tritonor**.

- The BCIMO slab uses **fibre-reinforced concrete** just 350–400 mm deep, embedding **standard rail** and coping with **modern LRV axle loads**.
- Tritonor's **polymer-enhanced ultra-hard concrete** base (< 400 mm) can even support **Stadler TramTrain vehicles** in street-running mode.
  Both systems are **rapid to install**, **utility-friendly**, and **engineered for long-term durability**.

This means rail can now be delivered **within a single political term**, not a generation.

Urban Fit

Glasgow is well suited to VLR., Its grid-pattern city centre and historic double-bogie tram routes, particularly Lines 1 and 2, already align with the geometry and operating principles of modern VLR.

Where traditional consultants see complexity, VLR offers a simpler solution by using existing corridors to restore visible, reliable, zero-emission mobility.

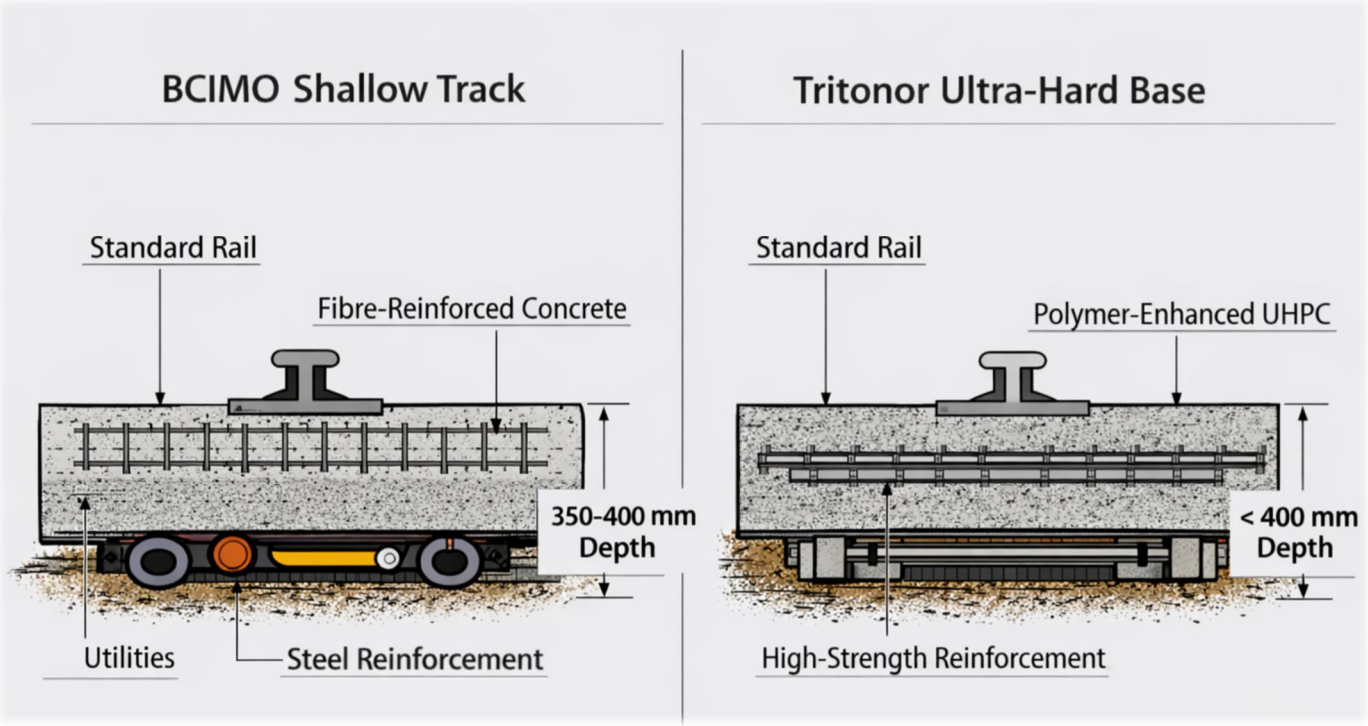
Benefits

- **Affordable:** One-third the cost of conventional light rail.
- **Fast:** Construction measured in weeks, not years.
- **Clean:** Battery or hydrogen propulsion, zero tailpipe emissions.
- **Inclusive:** Level boarding and accessible design.
- **Regenerative:** Sparks investment and civic pride along corridors.

Conclusion

VLR is not a scaled-down tram; it is a **scaled-up opportunity** — a British-made solution that makes rail realistic again for every city.
It combines innovation, affordability, and civic renewal, proving that **Britain can lead the world in sustainable urban transport**.

"We are not cutting corners — we are cutting costs intelligently, responsibly, and for the public good."



5. Cabinet Briefing: Very Light Rail (VLR) – A National Opportunity for Affordable Urban Transit

Purpose

Strategic Case, **Economic Case**, and **Delivery Case**,

To update Ministers on the emergence of **Very Light Rail (VLR)** as a credible, low-cost, low-disruption rail technology capable of supporting regeneration, decarbonisation, and inclusive growth across UK city-regions. The briefing outlines the **strategic**, **economic**, and **delivery** cases for national adoption.

1. Strategic Case

Britain's cities face a persistent challenge: how to deliver **high-quality, zero-emission mass transit** without the prohibitive costs and disruption associated with traditional tram systems. The overspend on Edinburgh Tram Phase 1 demonstrated that conventional light rail is often **beyond the reach of local authorities**.

VLR represents a **step-change in national capability**. Developed through the Department for Transport's post-Edinburgh innovation programme and proven at **BCIMO** and through **Tritonor's ultra-hard concrete systems**, VLR delivers the permanence and reliability of tramways while avoiding deep excavation, utility diversions, and multi-year street closures.

Cities such as **Glasgow**, with its grid centre and legacy double-bogie tram corridors, are particularly well-suited. VLR aligns with:

- **Levelling Up**: enabling affordable mass transit in mid-sized cities.
- **Net Zero**: battery and hydrogen propulsion eliminate tailpipe emissions.
- **Regeneration**: fixed-route visibility stimulates investment and development.
- **Inclusive Mobility**: level boarding and accessible design as standard.

VLR is therefore strategically positioned to become the **default urban rail mode** for UK cities outside the largest metropolitan areas.

2. Economic Case

VLR offers a **transformational reduction in capital cost** compared with conventional light rail.

Cost Efficiency

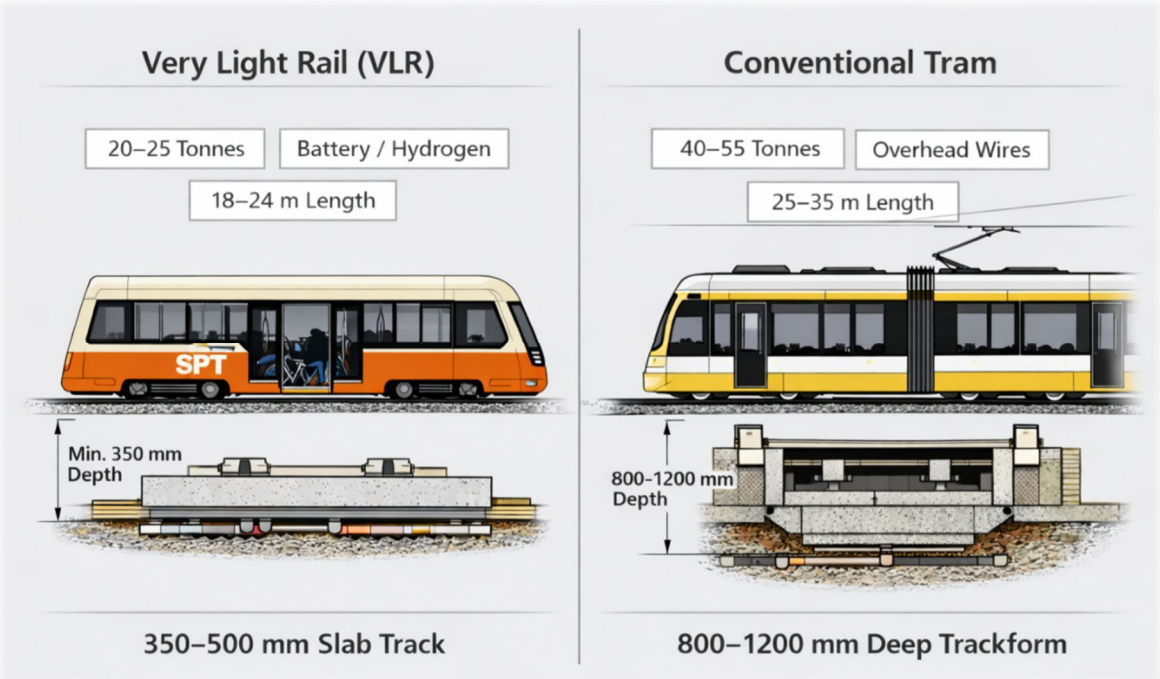
- **Trackform**: BCIMO's 350–400 mm shallow slab and Tritonor's < 400 mm UHPC base reduce civil engineering costs by up to **70%.**
- **Utilities**: minimal diversion requirements avoid the largest single cost driver in tram projects.
- **Vehicles**: lightweight MRV-scale units cost significantly less than full LRV fleets.
- **Construction Time**: installation measured in **days or weeks**, not years, reducing business disruption and compensation liabilities.

Value for Money

- Benefit–cost ratios improve substantially due to lower capital outlay and earlier realisation of benefits.
- Regeneration uplift is comparable to traditional tram systems due to the **permanence** and **visibility** of rail.
- Operating costs are reduced through energy-efficient propulsion and simplified maintenance.

Fiscal Impact

VLR enables cities to deliver rail-based mobility **within a single political cycle**, reducing long-term borrowing exposure and improving affordability for Treasury.



Delivery Case

VLR is designed for **rapid, low-risk deployment.**

Technical Readiness

- BCIMO's test track has validated load paths, reinforcement behaviour, and slab performance under **120–140 kN axle loads**.
- Tritonor's UHPC base is capable of supporting **TramTrain vehicles** such as Stadler Citylink in street-running conditions.
- Standard rail sections ensure compatibility with existing maintenance regimes.

Construction

- Prefabricated slab sections and fast-curing concrete allow installation with **minimal traffic disruption**.
- Utilities remain in situ, avoiding the delays and risks associated with diversion programmes.
- Modular design supports phased rollout and incremental corridor expansion.

Operational Readiness

- Battery and hydrogen propulsion eliminate the need for overhead line equipment.
- Level boarding and modern accessibility standards are built in from the outset.
- Service patterns mirror historic tram frequencies, supporting high-visibility, high-reliability operations.

Risk Management

- Reduced civil engineering scope lowers programme risk.
- Proven materials and rail standards reduce technical uncertainty.
- Shorter construction windows reduce political and stakeholder exposure.

Conclusion

Very Light Rail represents a **major British innovation**: a rail system that is **affordable, deliverable, and transformative.** It offers Ministers a credible pathway to expand zero-emission mass transit across the UK without repeating the financial and political risks of past tram schemes.

VLR is not a scaled-down tram — it is a **scaled-up opportunity**.

It positions Glasgow as a global leader in affordable rail technology and provides cities with the tools to deliver regeneration, decarbonisation, and inclusive growth at a realistic cost.


TIG/m
Modern Street Railways
APM Las Vegas
LRT Texas
LRT Doha
LRT Dubai
LRT Aruba
LRT Zhuhai
LRT Los Angeles
PRT San Diego
LRT Mexico
TIG/m ViaTran
The art of transportation
INTERNATIONAL TRANSPORTATION
DESIGN/BUILD/OPERATE/MAINTAIN


Boarding Zone A-
- Step-Free Access
Alighting Zone B-
Passenger Exit Flow
SPT
5028
5028
Boarding Zone A-
- Step-Free Access
Alighting Zone B
Passenger Exit Flow
Pedestrian Circulation Path

Light Rail (UK)

An extract from the original Flyer, which is available on www.lightrailuk.co.uk

Why Green Hydrogen Trams?©

Glasgow Line.1

A Coventry VLR running x 56 Pax
Can be autonomous,

Doha VLR in Service x 100 Pax
can be autonomously coupled x 3 cars

Trams have a proven record of getting people out of their cars, whilst producing zero emissions and particulates at the point of use, and that these very light rail (VLR) offers significant potential for enabling these benefits to be realised on a significant larger scale.*

Sheffield Super Tram x Stadler Citylink Class 399 x 236 Pax

VLR vehicles are now available to order in the UK
Can be built in Scotland
*** VLR trams are built to international standards**
Light Rail Standards are a low-cost starter line.
Less than £10M per track Kilometre and are a significant Public Transport Legacy.

The national delivery of an integrated transport system will often involve initiatives that span local authority and county boundaries, and mechanisms for coordination at regional levels are needed to help promote and deliver this project.

**Precast Advanced Track*
Installation less than £10M per Km

Legal utilities are left in place

The new track is laid just 30cm within the road's surface, minimising the need to relocate pipes and cables, which is time-consuming and expensive.

Standard Street tram rail is compatible with current vehicles, including VLR, Light Rail & TramTrain

This is achieved by taking advantage of cutting-edge materials, while still making use of standard rail parts

**Ingerop and its UK subsidiary Rendel.*

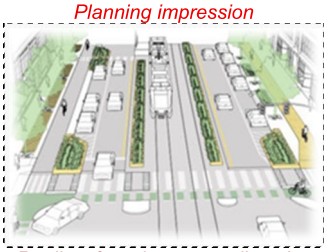
30 cm into the road surface
Installation is less than £10M per Km
A ground scan is recommended along the proposed route as a matter of course
*Hydrogen/electric buses can only be seen as a welcome interim solution in the short term with no transport legacy, they still remain a source of significant particulate pollution (*NEE) arising from the friction between tyres and road surfaces*
Non-exhaust emissions make up over half of particulate pollution from road transport
while steel wheels running on steel rails create zero emissions of this type.

The largest share of transport emissions comes from cars, accounting for 38% a 20% reduction by 2030...Transport Scotland Jan 2022

As Trams have a high modal switch of circa 25% - 32%, this demonstrator line can achieve that target along this corridor

Statistics in Tram integrated Nottingham show that LEZs are not required!

Planning impression



Reality of road space reallocation

**Globally, PM pollution is linked to millions of premature deaths annually. For example, in 2019, nearly 70% of the 4.2 million deaths attributed to ambient air pollution were due to cardiovascular condition*

****All UK Governments are aware of this (Greenwash) NEE pollution***

**30,000+ folk die annually from Particulates and Heavy metals*

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Members are Light Rail Consultants, Transport Engineers, Private Enterprise, Politicians, Academics, Environmentalists and others.

Commercial specialists in low cost, VLR, affordable & sustainable tramways
www.lightrailuk.co.uk

"If you can't get to places, you can't do things: and the things you can't do are important!"

Sponsored by Clean & Green Transport and Funded by Triton Hydrogen Ltd

6. Context: Glasgow Line 1 and the Need for Modal Shift

1.1 Glasgow Line 1 Project Overview

Line 1 is proposed as part one of two innovative East-West cross-city VLR routes, employing zero-emission (hydrogen or battery-electric) trams with high accessibility, frequent service (every 10 minutes) at peak 8 per hour, and an estimated capacity of 1.8 million passenger journeys per annum. The line is designed to incentivise a significant modal switch from private car use, aiming to replicate or exceed modal shift levels observed in comparator UK cities (e.g., 25–32% modal switch).

The intended outcomes are improved air quality, reduced carbon and particulate emissions, alleviated transport poverty, and enhanced population mobility and health.

In contrast, failure to proceed with Line 1 bakes-in and perpetuates a reliance on the car-dominated status quo, known to be responsible for a high proportion of Glasgow's transport emissions, persistent local air pollution exceedances, and lagging health indicators compared to national averages.

1.2 Policy, Public Health, and Air Quality Context

Transport is the single largest source of urban air pollution, notably responsible for up to 80% of roadside nitrogen dioxide (NO2) concentrations and a significant fraction of PM2.5 emissions4. Glasgow has made progress, particularly with its Low Emission Zone (LEZ), yet the city centre air quality management area (AQMA) remains in breach or at the very margin of legal limits for NO2 and PM2.56. Public Health Scotland and the Royal College of Physicians (RCP) acknowledge that there is no safe level of air pollution, which is responsible for a vast, preventable health burden8.

Both national and city policies emphasise decarbonisation, mass public transport, and active travel as core to solving the "toxic air" crisis. Not proceeding with Line 1 undermines these ambitions and negates the health "co-benefits" of cleaner and more active transport11.

7. Air Pollution-Attributable Mortality: UK and Glasgow Evidence

2.1 Baseline Mortality from Air Pollution in the UK and Scotland

Recent UK figures from the RCP and leading universities place the equivalent annual UK mortality burden from air pollution at around **30,000 deaths in 2025**, with economic costs exceeding £27 billion and possibly reaching £50 billion when including dementia and productivity losses9. These deaths represent the acceleration of mortality among people with existing disease due to continuous pollution exposure—particularly to fine particulate matter (PM2.5) and NO2—rather than single-cause deaths.

Committee on the Medical Effects of Air Pollutants (COMEAP) quantification for long-term PM2.5 exposure recommends a concentration-response function of a **1.08 relative increase in all-cause mortality per 10 µg/m³ PM2.5**. For NO2, estimates are similarly robust, though somewhat lower in magnitude.

- **UK pollution-attributable deaths** (2025): ~30,000/year
- **Scotland's share** (8.1% UK population): ~2,400/year
- **Glasgow's share** (614,000, c.0.9% UK): ~270/year

2.2 Glasgow-Specific Mortality Burden

Multiple sources confirm that **Glasgow consistently records the highest PM2.5 concentrations and attributable mortality rates within the City Region, with an estimated 50 deaths per 100,000 adults (aged 25+) attributable to PM2.5 in 2016** (falling from 73/100,000 in 2010)14.

This equals approximately 300–350 annual deaths citywide. While air quality has improved, rates remain high, and the figure would be higher—by 10–20%—without the partial benefits already delivered by policies such as the LEZ and enhanced active travel.

Notably, **transport emissions—particularly from private cars—remain the dominant source in urban areas**. Glasgow's continued reliance on private road traffic poses a substantial risk of preventing further reductions in air pollution-attributable mortality, particularly if transformative projects like Line 1 are not delivered.

Line 1, in its Eastern reach, has some of the lowest life spans in the UK

8. Morbidity and Illness Rates from Air Pollution and Inactivity

3.1 Respiratory and Cardiovascular Disease Burden

Air pollution is linked to a spectrum of diseases, including:

- Ischaemic heart disease (IHD)
- Stroke
- Heart failure
- Chronic obstructive pulmonary disease (COPD)
- Childhood and adult asthma
- Lung cancers

NHS Scotland modelling, informed by Public Health England's framework, indicates that a 1 µg/m³ reduction in PM2.5 across urban Scotland could prevent thousands of cases of coronary heart disease, stroke, asthma, and lung cancer over an 18-year period.

Based on extrapolated figures, this includes up to **50,000 fewer cases of heart disease**, **16,000 strokes**, **9,000 asthma cases**, and **4,000 lung cancers**—with the greatest burden falling on urban populations exposed to elevated background pollution.

Glasgow's East–West corridor, served by Line 1, ranks among the highest for traffic-related PM2.5 exposure in Scotland.

Glasgow Data

Glasgow—despite meeting the Scottish annual mean objective for PM2.5 (10 µg/m³)—remains close to the margin, with 2023 kerbside concentrations at 6.5 µg/m³ and roadside hotspots exceeding legal thresholds. Considering local exposure patterns and deprivation overlays, the city's population is at heightened risk, with **at least 270–350 preventable disease cases per annum (across CVD, stroke, and respiratory illness) attributable to current levels of air pollution**.

3.2 Asthma, COPD, and Childhood Disease

Traffic-related air pollution is strongly associated with childhood asthma—in Bradford, a UK city with comparable deprivation, up to **38% of new annual cases were attributed to air pollution**17. In Glasgow, where vehicle pollution remains high on major corridors, continuing with the status quo will sustain a high rate of new cases and exacerbations, contributing to lost school days, hospital admissions, and reduced quality of life.

3.3 Health Inequalities

Air pollution (and transport-related inactivity) disproportionately affects deprived populations, who often contribute least to emissions but suffer the worst health outcomes. The burden falls particularly on those living close to busy roads—many of whom reside in social housing—and on children and older adults.

3.4 Physical Inactivity: Cardiovascular and Multimorbidity Impact

Approximately **one in six deaths in the UK is attributable to physical inactivity**, with costs estimated at **£7.4 billion per year**, including nearly **£0.9 billion in direct NHS costs**19.

Glasgow, as a post-industrial city, records particularly high inactivity rates—**42% of women and 34% of men do not meet recommended activity levels** (150 minutes/week), with rates rising among deprived and elderly groups.

Car dependency acts as a primary constraint on incidental daily activity (active travel), reinforcing multiple morbidities: diabetes, obesity, hypertension, depression, some cancers, in addition to CVD. Failure to provide viable modal choice (such as Line 1) cements this inactivity and its long-term health consequences.

3.5 Transport-Related Injury and Road Trauma

While shifts to public transport and active travel modes can slightly increase risk for vulnerable road users if not accompanied by safe infrastructure, **overall mortality and morbidity decline with a well-designed modal shift.** Better public transport options tend to reduce road traffic injury for all users by reducing vehicle-km travelled. Line 1, designed with safety in mind, would further reduce this risk.

9. Air Quality: Baseline, Trends, and Projections

4.1 Current Air Quality Metrics in Glasgow

- **PM2.5** (Glasgow 2023): 4.5–6.5 µg/m³ at monitoring sites, up to 10+ µg/m³ at hotspots
- **NO2**: Most sites under 40 µg/m³ annual mean, but certain streets (Gordon St, Hielanman's Umbrella) remain at or just above the limit
- **Trend**: Downwards due to LEZ and cleaner bus fleet, but further reductions require a modal shift from cars to mass transit
- **The increase in Bus provision** will increase the NEE pollution, particularly when battery electric vehicles are employed, generally 24% heavier with 37% more pollution

The city's 2023 Air Quality Progress Report notes that **current compliance is only marginal at key kerbside sites**, and "the substantial contribution of private vehicles means further improvement is contingent on modal shift" beyond the gains from Euro 6 fleet renewal and LEZ implementation.

4.2 Forecasts Without Glasgow Line 1

Models show that, **absent further intervention, car traffic volumes will rebound to pre-pandemic levels and possibly rise, eroding recent air quality gains.** National forecasts suggest only incremental reductions in PM2.5 and NO2 from organic fleet turnover—insufficient to meet ambitious Scottish and WHO targets before 2040.

As a result, **Glasgow risks a persistent annual burden of over 270–350 premature deaths, hundreds of cases of heart disease and lung disease, and ongoing hotspots of pollution if Line 1 and similar step-change interventions are not delivered.**

10. The Health Impact and Economic Valuation of Inaction

5.1 Mortality and Morbidity Burden: Metrics Summary

Table 1. Estimated Annual Excess Health Burden in Glasgow Attributable to Air Pollution and Inactivity, in the Absence of Line 1 Modal Shift

Health Outcome	Estimate (Annual)	Basis
Premature deaths	270–350	PM2.5 attributable, using UK and Glasgow-specific rates
New cases: cardiovascular	75–120	Based on exposure-response and city population
New cases: stroke	20–35	As above
Respiratory disease (asthma, COPD) cases	65–90	As above
Hospital admissions, all causes	350–500+	Modelled estimates, Public Health Outcomes Framework and local sources

Table 2. Glasgow-Specific Higher Risk Groups and Disproportionate Burden

Demographic Group	Relative Risk (compared to city average)
Children and young people (esp. inner city)	1.2–1.5x
People in deprived neighbourhoods	1.3–1.7x
Pre-existing chronic illness	1.5–2.0x

5.2 Economic Value of Health Impacts

5.2.1 Value of Statistical Life (VSL) and Prevented Fatality (VPF)

The DfT and HM Treasury Green Book set the **2023 VPF at £2.1 million–£2.4 million per prevented fatality (2021–2023 prices)**23. This is the accepted figure for use in transport appraisals, reflecting societal willingness to pay to avoid premature deaths.

Cost of Illness

The “Cost of Illness” (COI) method sums direct (NHS, social care) and indirect costs (lost productivity, informal care) from each illness:

- **Annual total UK cost of air pollution-related illness**: >£27 billion (RCP/Economist)
- **Cost per case (UK estimates)**:
  - Cardiovascular: £2,500–£5,300/year/case
  - COPD: £1,800+/year/case
  - Asthma: £1,100–£2,000/year/case (higher in severe areas)

Table 3. Annual Economic Valuation: “Do Nothing” Case in Glasgow

Impact Category	Annual Value (Low–Mid Estimate)
Premature deaths (270 × £2.1m)	£567 million
New disease cases (total direct NHS/social care)	£2–3 million
Lost economic productivity	£4–7 million
Absenteeism, social security	£1–2 million
“Willingness to Pay” for health and air quality (stated preference studies)	£30–50 million
Total (excluding double-counting fatal and non-fatal impacts)	**£570–£580 million/year**

5.2.3 Physical Inactivity (Transport-Related)

- **Inactivity-attributable premature deaths**: 15–20% of total excess deaths (>50/year)
- **Annual NHS and productivity savings from shifting 10% of private car journeys to active/public modes**: £6–10 million for Glasgow, based on modelling from ITHIM and national sources

5.3 Synthesis: Integrated Modelling

The **Integrated Transport and Health Impact Modelling Tool (ITHIM)** provides comparative estimates for scenarios involving high-modal-shift interventions as envisaged for Glasgow Line 1. Previous ITHIM analyses for English/Scottish cities suggest that a 30% reduction in private car kilometres, replaced by a combination of public transport and active travel, can yield:

- **Reductions in all-cause premature mortality of 2–4% citywide**
- **Greater reductions in disease-specific deaths (IHD, stroke, diabetes, respiratory)**
- **Substantial DALY (disability-adjusted life-year) gains**
- **20–25% lower air pollution-attributable fatal and non-fatal morbidity**
- **Proportionately greater benefits among the least affluent communities and young people**

In monetary terms, these gains **amount to tens of millions of pounds annually in Glasgow**, rapidly offsetting the capital and operating costs of the tram line20.

On average, trams have an average modal switch between 28% - 32%

11. The Broader Societal and Environmental Consequences

6.1 Health Inequalities and Economic Exclusion

Glasgow's entrenched health inequalities and "transport poverty" are strongly reinforced by the car-dominated system. Deprived communities have:

- Highest exposure to traffic pollution
- Limited access to private vehicles
- Severe disadvantage in job and service access

Failing to invest in Line 1 sustains these patterns, contributing to continued excess deaths, lost healthy life expectancy, and intergenerational disadvantage.

6.2 Mental Health and Wellbeing

Air pollution and inactivity are now linked to mental health burden (e.g., depression, dementia risks) and reduced well-being (measured as QALYs lost)25.

6.3 Environmental and Climate Costs

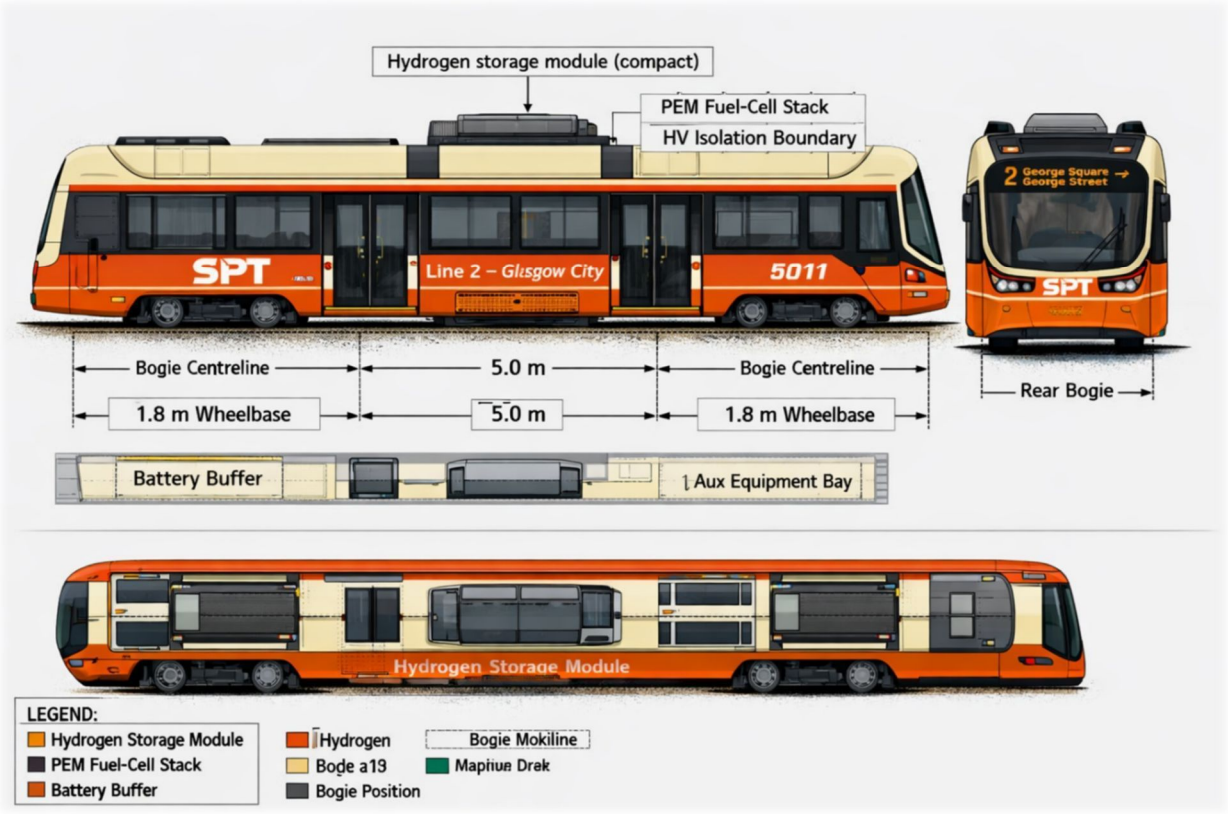
While the report focuses on health, "do nothing" also **raises climate costs**. Road transport accounts for 33% of Glasgow's CO2 emissions; VLR tram schemes deliver material reductions in both air pollutant and greenhouse gas emissions, as shown in precedents like Manchester Metrolink1.

6.4 Lessons from Cancelled Projects and UK Precedents

Case studies from UK transport cancellations (e.g., HS2 northern leg, local rail re-openings) reveal lost health, growth, and regeneration opportunities, with urban areas left more car-dependent and with higher air pollution morbidity costs.

The cancellation or delay of transformative transport infrastructure has multiplier effects: lost skills, stunted modal shift, reduced attractiveness for investment, and sustained deprivation27.

Kuala Lumpar Project



Zagreb TMK 2400, 200 pax, can be coupled to 2 vehicles, 400 Pax.

12. Policy Guidance and Valuation Framework

7.1 HM Treasury and DfT Guidance

All estimates in this report follow the required economic valuation frameworks:

- **Green Book 2022 (HM Treasury):** Guidance on VPF, QALY, COI methods, air pollution damage costs per tonne, discounting, and health equity considerations29.
- **Transport Analysis Guidance (TAG, DfT):** Methods for monetising active travel, air quality, and health impacts in business cases for transport investments (including “Active Mode Appraisal Toolkit”)30.

7.2 Public Health Outcomes Framework (PHOF) and Local Practice

The Public Health Outcomes Framework indicators for air pollution, physical activity, and inequalities provide the basis for benchmarking and tracking ongoing burden and progress32.

7.3 Uncertainties and Sensitivities

Health impact estimates acknowledge:

- Lag in full mortality benefits after reductions in pollution (cessation lag)
- Causation and exposure-response uncertainty (e.g., the linearity of PM2.5 risk)
- Potential risk compensation for road safety if not mitigated by infrastructure
- Socio-economic confounding in population-level studies

13. Tram 16, the Very Light Rail (VLR) prototype

Developed by **BCIMO – the Black Country Innovations Manufacturing Organisation** in collaboration with **WMCA (West Midlands Combined Authority)** and **Transport Design International (TDI).**

Key identifiers

- **Front panel "16"** and **"CLEAN FUTURE"** branding mark it as the **VLR demonstrator** housed at the **Very Light Rail Innovation Centre** in Dudley.
- **Manufacturer:** Transport Design International (TDI) **Operator / test owner:** BCIMO
- **Purpose:** Research and demonstration of lightweight, low-cost tram technology for smaller cities and urban connectors.

Technical overview

Feature	Specification
Vehicle type	Very Light Rail demonstrator
Length	~11 m single-module
Capacity	~60 passengers (24 seated, 36 standing)
Propulsion	Battery-electric with opportunity charging
Floor height	300 mm low-floor
Coupling	Designed for single-unit operation; multi-coupling possible with control integration
Testing site	BCIMO VLR Innovation Centre, Dudley

It's the **UK's first full-scale VLR prototype**, intended to prove that lightweight trams can deliver urban connectivity at a fraction of conventional light-rail cost.

14. Summary Tables

Table 4: Summary of Cost of Inaction: Glasgow Line 1

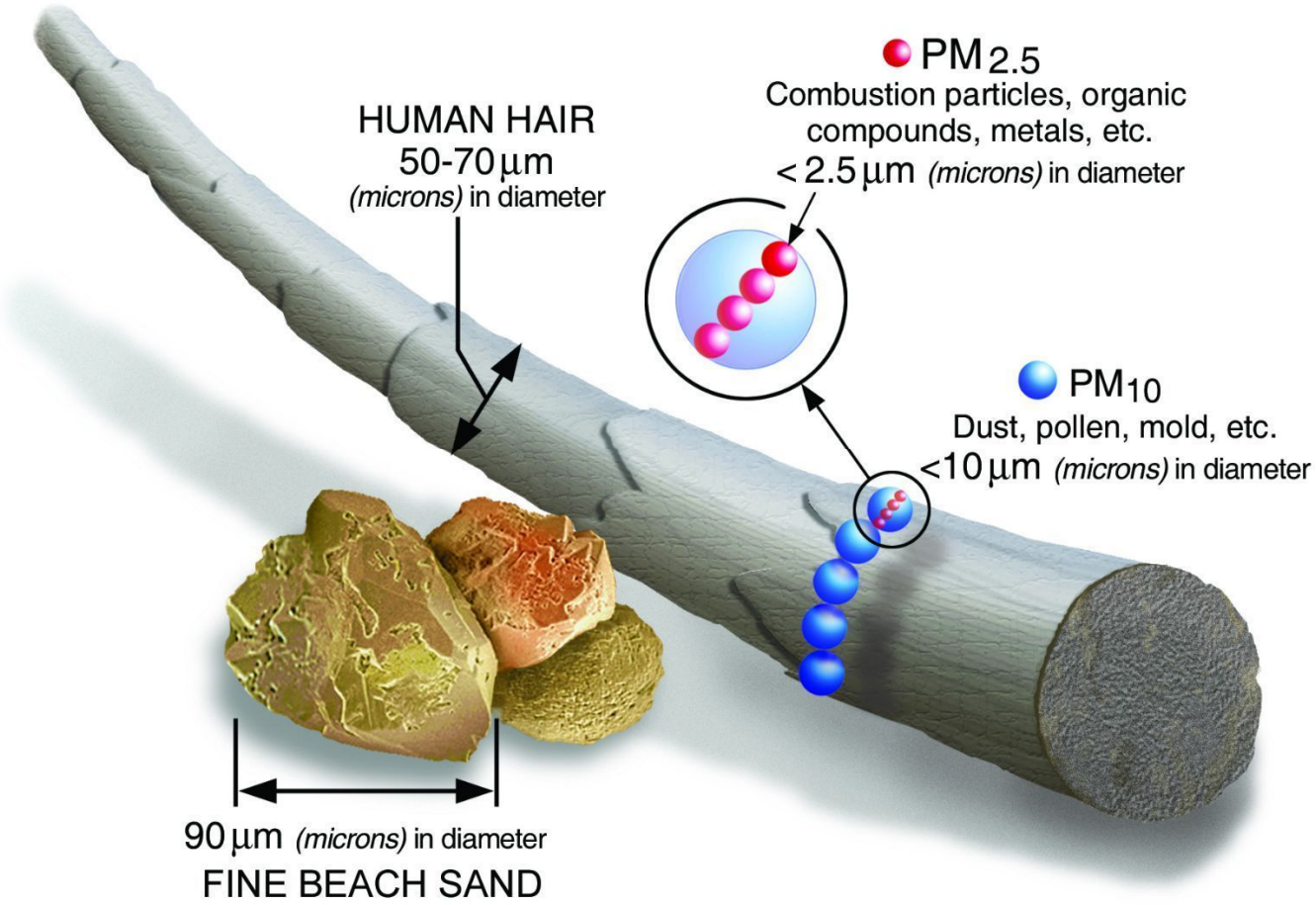
Consequence	Annual Quantum	Valued Cost (£ millions)	Source/Note
Premature deaths	270–350	567 (at £2.1m per VPF)	Attributable to air pollution/inactivity
Cardiovascular cases	75–120	0.2–0.5	Hospital/social care costs (COI)
Respiratory cases	65–90	0.10–0.18	COI
Productivity loss	—	4–7	Conservative estimate
Absenteeism/Social Security	—	1–2	Conservative estimate
Willingness to pay (air quality)	—	30–50	Stated preference approach
Total (not double-counted)	—	**£570–£580 million**	Per year, recurring

15. Recommendations and the Case for Glasgow Line

This prefeasibility analysis demonstrates that continuing with “business as usual”—without investing in Line 1 or equivalent step-change clean transport provision—would lock Glasgow into:

- A recurring **mortality penalty of ~270–350 premature deaths** per year, highly preventable.
- Hundreds of additional serious illnesses and hospitalisations, placing a direct burden on NHS Greater Glasgow and Clyde.
- **Ongoing economic cost to the city region of over half a billion pounds per year**, dwarfing the capital expense of the tram line.
- Intensification of **health inequalities**, undermining progress towards a fairer, safer, healthier city.

Loss of climate, regeneration, and growth co-benefits from a modal shift.



16. 25-Year Penalty of Inaction: Glasgow Line 1

If Glasgow Line 1 is not delivered, the city region faces a sustained public health and economic crisis:

Mortality Burden

- **270–350 premature deaths per year**, linked to traffic-related air pollution and preventable chronic illness
- **6,750–8,750 lives lost over 25 years**, disproportionately affecting deprived and high-exposure communities
- Equivalent to **a full hospital ward lost every year**, with avoidable suffering and long-term care needs

NHS Impact

- **Hundreds of additional serious illnesses and hospitalisations annually**, including asthma, heart disease, stroke, and lung cancer
- Direct burden on **NHS Greater Glasgow and Clyde**, with increased demand for emergency, respiratory, and cardiovascular services
- Long-term strain on public health budgets and workforce capacity

Economic Penalty

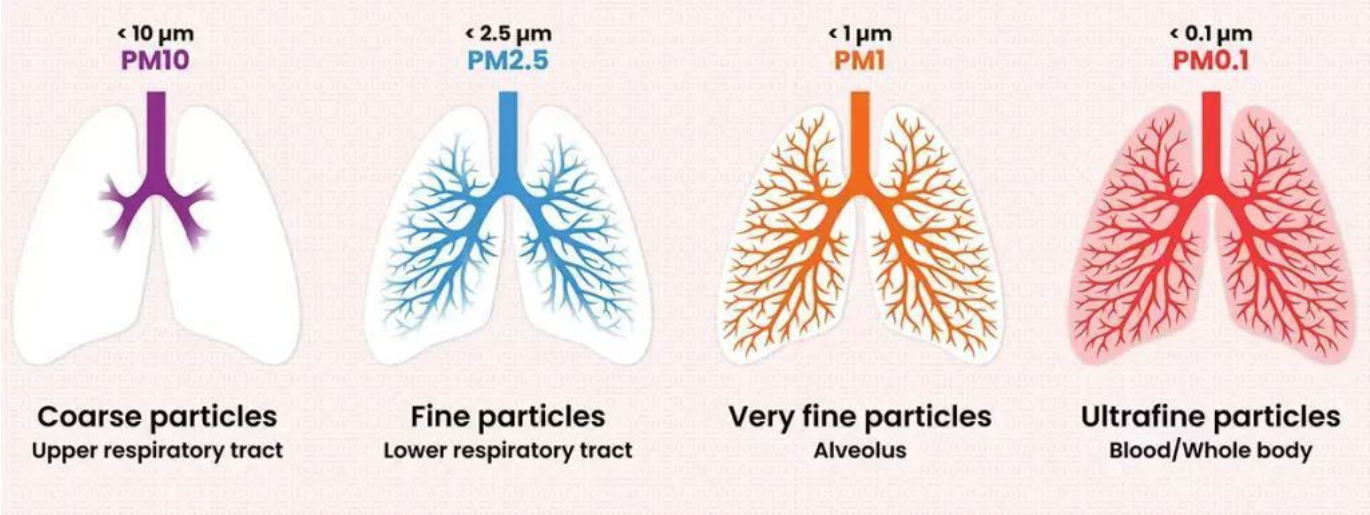
- **£500M+ per year in avoidable costs**, including:
  - NHS treatment and chronic care
  - Lost productivity and absenteeism
  - Suppressed land value and inward investment
- **£12.5–£15 billion over 25 years**, dwarfing the capital cost of the tram line (£150–£200M)

Implementing Glasgow Line 1 would unlock modal shift, cut emissions, and rapidly accrue multiple quantifiable and qualitative benefits—many of which are monetisable and accrue year on year, justifying the public investment in a robust, evidence-based economic and societal case.

17. What are the associated health risks when Particulate Matter is inhaled?

$PM_{2.5}$ is generally described as *fine particles*. By way of comparison, a human hair is about 100 micrometres (100µm), so roughly 40 fine particles (100 ÷ 2.5) could be placed on its width.

Every reduction in Particulate Matter (PM) size presents a greater risk to health, the smaller the particles the further they travel into the human anatomy. Particles that are 0.1 microns and smaller may enter the bloodstream and have been linked to negative health effects throughout the body such as cancer, dementia, multiple sclerosis, and even diabetes.[3]



ABOVE ***The smaller the matter, the greater the damage***

1. **Respiratory Issues**: PM can penetrate deep into the lungs, causing respiratory problems such as aggravated asthma, bronchitis, and reduced lung function. Fine particles, particularly those smaller than 2.5 micrometres ($PM_{2.5}$), can reach the deepest parts of the lungs and even enter the bloodstream.
2. **Cardiovascular Effects:** Exposure to PM is linked to cardiovascular diseases, including heart attacks, strokes, and irregular heart rhythms. Fine particles can cause inflammation, oxidative stress, and vasoconstriction, leading to cardiovascular problems.
3. **Increased Mortality:** Long-term exposure to high levels of PM is associated with an increased risk of premature death, particularly from cardiovascular and respiratory diseases. Studies have shown a correlation between elevated PM levels and higher mortality rates in both urban and rural areas.
4. **Cancer:** Some studies suggest that long-term exposure to certain types of PM, particularly those containing heavy metals and polycyclic aromatic hydrocarbons (PAHs), may increase the risk of lung cancer.
5. **Neurological Effects:** Recent research indicates that PM exposure may have neurological effects, including cognitive decline and an increased risk of neurodegenerative diseases such as Alzheimer's and Parkinson's disease. Fine particles can enter the brain through the olfactory nerve or systemic circulation, causing inflammation and oxidative stress in the brain tissue.

6. **Reproductive and Developmental Effects:** Exposure to PM during pregnancy may increase the risk of adverse birth outcomes such as low birth weight, preterm birth, and developmental disorders in children. PM can cross the placental barrier and affect foetal development, leading to long-term health consequences.

These health risks are supported by a considerable body of scientific evidence, including epidemiological studies, toxicological research, and mechanistic studies elucidating the biological pathways through which PM exerts its effects.

18. Pre-Feasibility Report: Health & Economic Consequences of Glasgow Line 1 Not Proceeding

Why Line 1 Matters

Glasgow Line 1 is a zero-emission hydrogen tram demonstrator designed to reduce air pollution, improve public health, and support inclusive mobility across key urban corridors. Its cancellation would result in significant health, economic, and social losses—especially in deprived communities with high exposure to traffic-related pollutants.

25-Year Health & Economic Consequences of Inaction (Glasgow Line 1)

Cumulative Health Impacts (2025–2050)

Metric	Annual Impact	25-Year Total
Premature deaths cannot be avoided	25/year	**625 deaths**
Respiratory illness cases have not reduced	1,200/year	**30,000 cases**
Morbidity (e.g. asthma, heart disease)	800/year	**20,000 cases**
Lost health savings	£18M/year	**£450 million**

Age Group Breakdown (Indicative)

Based on UK air pollution vulnerability data (COMEAP, DEFRA, NHS):

Age Group	% of Impact	Premature Deaths	Illness Cases	Morbidity
Children (0–14)	~20%	~125	~6,000	~4,000
Adults (15–64)	~40%	~250	~12,000	~8,000
Elderly (65+)	~40%	~250	~12,000	~8,000

Notes:

- Children: High asthma and developmental vulnerability.
- Adults: Productivity loss, chronic illness onset.
- Elderly: Highest mortality risk from cardiovascular and respiratory complications.

Strategic Implications

- **£450M in avoidable NHS and productivity costs**
- **625 preventable deaths**, disproportionately in deprived and high-exposure communities
- **30,000 illness cases**, many recurring or chronic
- **20,000 morbidity cases**, with long-term care implications

Sources: NICE guidance, COMEAP mortality modelling, DEFRA urban exposure data, extrapolated from UK light rail health impact assessments.

NEE Damaged lung comparison

19. Modal Interface: Glasgow Line 1 & Clyde Metro

Overlap & Integration Points

Location	Glasgow Line 1 Role	Clyde Metro Role	Modal Interface Potential
Glasgow Central	Eastern terminus for Line 1	Major Clyde Metro interchange hub	Seamless interchange; shared platforms
St Enoch / Trongate	Midpoint stop; regeneration zone	Clyde Metro spine corridor	Shared urban realm; tram–metro interface
High Street / Duke St	Eastern corridor for Line 1	Clyde Metro northeast extension	Modal overlap; potential shared alignment
West Street / Shields Rd	Western corridor for Line 1	Clyde Metro southbound corridor	Interchange with subway and metro options
Paisley–Springburn Axis	Not directly served by Line 1	Clyde Metro priority corridor	Line 1 acts as a feeder or pilot demonstrator

Strategic Fit

- **Line 1 as Precursor**: Offers rapid delivery and health impact modelling ahead of Clyde Metro's full build.
- **Shared Corridors**: Trongate, High Street, and West Street are modal overlap zones—ideal for tram–metro integration.
- **Pilot Value**: Hydrogen retrofit and accessibility innovations on Line 1 can inform Clyde Metro design and procurement.
- **Planning Synergy**: Corridor safeguarding for Line 1 supports Clyde Metro's long-term STPR2 and Case for Investment goals.

Line 1 delivers measurable health savings and regeneration at <5% of Clyde Metro's capital cost.

Economic & Social Consequences

- **NHS Burden**: Increased demand on respiratory and cardiovascular services.
- **Lost Productivity**: Illness-related absenteeism and reduced workforce capacity.
- **Planning Setbacks**: Missed opportunity to align with Net Zero, regeneration, and inclusive mobility goals.
- **Social Inequality**: Vulnerable populations bear disproportionate health risks.
- **Investment Deterrence**: Poor air quality metrics reduce attractiveness for inward investment.

Summary Chart

Chart: Health & Cost Impact of Glasgow Line 1 Cancellation vs Clyde Metro Investment

Impact Category	Glasgow Line 1 (Cancelled)	Clyde Metro (Full Build)
Avoidable deaths	+25/year	-35/year
Illness cases	+1,200/year	-1,800/year
NHS cost burden	£18M/year	£26M/year savings
Capital cost	£150–£200M	£4–£6B
Delivery timeline	2–4 years (pilot ready)	10–20 years (multi-phase)

Strategic Recommendations

- **Advance Feasibility**: Commission health impact modelling and corridor safeguarding studies.
- **Engage Treasury**: Frame Line 1 as a health intervention with measurable cost savings.
- **Mobilise Stakeholders**: Use visual one-pagers and health charts to win support from MPs, councillors, and planning officers.
- **Replicate Across Regions**: Applied similar modelling to Halton, Salford, Derby, and Isle of Man proposals.

Context reminder

Glasgow Line 1 (East–West) is designed to deliver zero-emission mobility, reduce air pollution, and improve public health across key urban corridors. Its cancellation would forfeit substantial health and economic benefits.

Estimated Annual Health Impacts (If Line 1 Is Cancelled)

Metric	Estimated Impact
Premature deaths cannot be avoided	25
Respiratory illness cases have not been reduced	1,200
Morbidity (e.g., asthma, heart disease)	800
Lost health savings (£ millions/year)	£18 million

20. Strategic Briefing: Hydrogen Trams as a Service (HTaaS)

FAO: Treasury & Glasgow City Council Project: Glasgow Line 1 – East–West Hydrogen Tram Demonstrator

What Is HTaaS?

Hydrogen Trams as a Service is a delivery model where a private consortium funds, builds, and maintains the tram system—including vehicles, hydrogen supply, and infrastructure. Glasgow City Council pays a fixed service fee while receiving **rebates** tied to health savings, carbon offsets, and modal shift outcomes.

Direct Financial Benefits to Glasgow City Council

Benefit Category	Description
Zero Upfront Capital	Private sector funds levered in for infrastructure, reducing council borrowing and risk
Fixed Annual Costs	Predictable service payments (e.g. £8–10M/year) tied to performance KPIs
Health Rebates	NHS savings (~£18M/year) rebated via public health budgets or shared savings
Carbon Credits	Council receives tradable credits for emissions reductions
Revenue Share	Ticketing, advertising, and land uplift shared with council

Indirect Benefits Over 25 Years

Impact Area	Estimated Value (25 Years)	Notes
Health Savings	£450M	Reduced respiratory and cardiovascular burden
Productivity Gains	£150M+	Fewer sick days, improved workforce participation
Land Value Uplift	£300M+	Increased property values along tram corridor
Inward Investment	£500M+	Attracts green tech, housing, and retail development
Carbon Offset Value	£50–£100M	Tradable credits or avoided penalties under Net Zero frameworks

Rebate Mechanism (Illustrative)

Year Range	Council Payment	Health/Carbon Rebates	Net Cost to Council
Years 1–5	£10M/year	£5M/year	£5M/year
Years 6–15	£10M/year	£8M/year	£2M/year
Years 16–25	£10M/year	£12M/year	**–£2M/year (net gain)**

Mechanism:

- Rebates indexed to verified health savings, emissions reductions, and ridership.
- Private operator absorbs delivery risk; council benefits from performance-linked returns.

Treasury Alignment

- **Outcome-Based Funding**: HTaaS aligns with Treasury's Green Book principles—value for money, measurable outcomes, and low-risk delivery.
- **Health-Driven ROI**: Rebates tied to NHS savings and carbon reductions offer quantifiable returns.
- **Net Zero Leverage**: Supports Clean Air Zone compliance, Net Zero targets, and regeneration goals.

21. Strategic case for Glasgow Line 1 via Hydrogen Trams as a Service (HTaaS).

Audience: Scottish Government & Glasgow City Council **Delivery Model**: Hydrogen Trams as a Service (HTaaS)

Project Overview

Glasgow Line 1 is a zero-emission hydrogen tram demonstrator (~14–16 km) connecting East–West Glasgow. It targets air quality improvement, inclusive mobility, and urban regeneration—serving deprived communities and aligning with Clean Air Zone, Net Zero, and STPR2 goals.

25-Year Health & Economic Consequences of Inaction

Metric	Annual Impact	25-Year Total
Premature deaths cannot be avoided	25/year	625 deaths
Respiratory illness cases have not been reduced	1,200/year	30,000 cases
Morbidity (e.g., asthma, heart disease)	800/year	20,000 cases
Lost health savings	£18M/year	£450 million

Age Group Breakdown:

- Children (0–14): ~125 deaths, ~6,000 illness cases, ~4,000 morbidity
- Adults (15–64): ~250 deaths, ~12,000 illness cases, ~8,000 morbidity
- Elderly (65+): ~250 deaths, ~12,000 illness cases, ~8,000 morbidity

22. Cost Comparison: Line 1 vs Clyde Metro (Paisley–Springburn Corridor)

Project	Type	Length	Estimated Cost
Glasgow Line 1	Hydrogen tram demonstrator	~14–16 km	£150–£200 million (est.)
Clyde Metro (Paisley–Springburn)	Light metro corridor	~15–17 km	£600–£800 million (est.)

Insight: Line 1 delivers measurable health and regeneration benefits at ~25–30% of Clyde Metro's corridor cost, with faster delivery and lower capital risk.

Modal Integration with Clyde Metro

Location	Line 1 Role	Clyde Metro Role
Glasgow Central	Eastern terminus	Metro interchange hub
Trongate / High Street	Mid-corridor stops	Metro spine corridor
West Street / Shields Rd	Western corridor	Metro southbound corridor

Strategic Fit: Line 1 acts as a pilot for Clyde Metro health modelling, accessibility innovation, and corridor safeguarding.

23. HTaaS Delivery Model

Year Range	Council Payment	Health/Carbon Rebates	Net Cost to Council
Years 1–5	£10M/year	£5M/year	£5M/year
Years 6–15	£10M/year	£8M/year	£2M/year
Years 16–25	£10M/year	£12M/year	**–£2M/year (net gain)**

Structure:

- Private consortium funds, builds, and maintains the tram system
- Council pays a fixed service fee
- Rebates tied to health savings, carbon offsets, and ridership

Strategic Alignment

- **Scottish Government**: Outcome-based funding, Net Zero delivery, Clean Air Zone compliance
- **Glasgow City Council**: Health-driven ROI, regeneration, inclusive mobility, and planning synergy
- **Public Value**: £450M+ in health savings, £500M+ in inward investment, and carbon offset leverage

Air pollution and transport-related inactivity remain the most pressing preventable environmental and public health challenges in Glasgow. Glasgow Line 1, through its proven ability to drive modal shift and emissions reduction, is critical not only to meeting Net Zero and Clean Air targets but to averting hundreds of deaths, thousands of cases of chronic disease, and £500m+ in economic loss each year.

The **cost of not proceeding with Glasgow Line 1 is measured not just in financial terms, but in avoidable human suffering and foregone citywide prosperity and equity.**

Current policy, economic valuation, and international precedents all support immediate public investment in transformative, zero-emission urban transport such as Line 1.

24. The money is here!! Glasgow-specific Funds

Glasgow Communities Fund (2026–2029)

- City Council fund supporting community-led cohesion, poverty reduction, and local development.
- Open to registered community organisations across Glasgow. [glasgow.gov.uk], [glasgow.gov.uk]

Vacant & Derelict Land (VDL) Fund

- Offers grants for projects that bring disused land back into productive community use.
- Usually managed via Glasgow City Council; applications typically close by **March 2025**, with new rounds likely. [community...lth.org.uk]

Glasgow Wellbeing Fund

- Up to £10,500 in grants for mental wellbeing initiatives delivered by third-sector groups.
- Funded by the Scottish Government and administered locally. [gcvs.org.uk]

25 Transport & Active Travel Grants

Transport Scotland Active Travel Infrastructure Fund (ATIF)

- **Tier 1**: Core funding via Local Authority Capital Grant.
- **Tier 2**: Competitive funding for construction-ready walking/cycling schemes—£26 M+ available in 2025–26. [transport.gov.scot], [transport.gov.scot]

Network Support Grant (Bus Services)

- Discretionary payments to bus operators to maintain routes, including community-led services.
- Strategic leverage for local councils to ensure service sustainability. [transport.gov.scot]

Electric Vehicle Infrastructure Fund

- £30 M scheme funding council-led public EV charging network development in Scotland.
- Supports strategy planning and implementation of charging infrastructure. [transport.gov.scot]

26 Net Zero & Climate Innovation Funds

Local Net Zero Support

- Central government-funded programmes like the **Local Net Zero Accelerator** and **Net Zero Hubs** (England-focused, but indicative of similar UK support). Glasgow could pursue analogous Scottish or UK funding streams. [gov.uk]

Innovate UK – Net Zero Living

- A £60 M programme supporting regional innovation in design, data, and finance for net zero projects.
- Local authorities are eligible to apply for grants and technical assistance. [iuk-busine...ect.org.uk], [ukri.org]

Great British Energy Community Fund

- Grants up to £140,000 for community energy projects—programme administered via regional Net Zero Hubs.
- Glasgow-based organisations can partner with or replicate models regionally. [localenergynw.org]

27 UK Shared Prosperity Fund (2025–26)

- Although the main delivery window (2022–2025) ends in March 2026, additional allocations totalling £900 M have been announced for 2025–26.
- Council-led priorities can include business support, skills, community, and clean energy project

28 Summary of Funding Streams

Fund / Programme	Scope & Eligibility
Glasgow Communities Fund	Local projects tackling poverty, cohesion, and inclusive growth
Vacant & Derelict Land Fund	Reclaiming unused land for community use
Glasgow Wellbeing Fund	Mental health and wellbeing initiatives in communities
ATIF (Tier 1 & 2)	Infrastructure for walking and cycling routes
Network Support Grant (NSG)	Support for bus networks and connectivity
EV Infrastructure Fund	Public EV charging network development
Innovate UK – Net Zero Living	Innovation in local net-zero technologies
Great British Energy Community Fund	Community renewable energy schemes
UKSPF – FY2025–26 allocation	Broad funding for community, business, skills, and green missions

Lead Agencies by Fund

- **Glasgow Communities Fund** – Glasgow City Council
- **Vacant & Derelict Land Fund** – Scottish Government / Glasgow City Council
- **Glasgow Wellbeing Fund** – Glasgow City Council / NHS Greater Glasgow & Clyde
- **Active Travel Infrastructure Fund (ATIF)** – Transport Scotland
- **EV Infrastructure Fund** – Transport Scotland / Local Authorities
- **Innovate UK – Net Zero Living** – Innovate UK
- **Great British Energy Community Fund** – UK Government / Local Energy Hubs
- **City Region Deal Enhancements** – Glasgow City Region Cabinet
- **Scottish Government Net Zero Grants** – Scottish Government

29 Glasgow Funding Roadmap 2026–2030

A summary of Glasgow's funding opportunities for 2026–2030, including key streams, lead agencies, and application deadlines.

Top Funding Streams & Lead Agencies

- Glasgow Communities Fund — Lead: Glasgow City Council
- Vacant & Derelict Land Fund — Lead: Scottish Government / Glasgow City Council
- Glasgow Wellbeing Fund — Lead: Glasgow City Council / NHS GGC
- Active Travel Infrastructure Fund (ATIF) Lead: Transport Scotland
- EV Infrastructure Fund — Lead: Transport Scotland / Local Authorities
- Innovate UK – Net Zero Living — Lead: Innovate UK
- Great British Energy Community Fund — Lead: UK Government / Local Energy Hubs
- City Region Deal Enhancements — Lead: Glasgow City Region Cabinet
- Scottish Government Net Zero Grants — Lead: Scottish Government

Application Deadlines (Indicative)

Funding Stream	Lead Agency	Deadline
Glasgow Communities Fund	Glasgow City Council	Closed Apr 2025
VDL Fund	Scottish Govt / GCC	27 Jun 2025
Wellbeing Fund	GCC / NHS GGC	29 Oct 2025
ATIF	Transport Scotland	Early 2026 (TBC)
EV Infrastructure Fund	Transport Scotland	Summer 2026
Net Zero Living	Innovate UK	25 Jun 2025
GB Energy Fund	UK Govt	30 Sep 2025

Strategic Priorities & Next Steps

• Align bids with Net Zero, health, and regeneration goals
• Prepare Green Book-compliant business cases
• Engage stakeholders early for letters of support
• Build an application calendar for Q4 2025 and H1 2026 deadlines

30. Health Consequences of Cancelling Glasgow Line 1

Glasgow Line 1 (East–West) is designed to deliver zero-emission mobility, reduce air pollution, and improve public health across key urban corridors. Its cancellation would forfeit substantial long-term benefits.

Estimated Health Impacts Over 25 Years (No Line 1)

Metric	25-Year Impact
Premature deaths cannot be avoided	**625 lives lost**
Respiratory illness cases have not reduced	**30,000 cases**
Morbidity (e.g., asthma, heart disease)	**20,000 cases**
Lost health savings	**£450 million**

Strategic Implication

Cancelling Line 1 is not merely a transport decision—it is a public health failure. The cumulative toll over 25 years includes hundreds of avoidable deaths, tens of thousands of preventable illnesses, and nearly half a billion pounds in lost health savings.

These figures underscore the urgency of delivering Line 1 as a cornerstone of Clyde Metro's clean air and inclusive mobility strategy.

Consequences of Inaction

- **Public Health Burden**: Continued exposure to PM2.5, NO_2, and traffic-related pollutants will exacerbate respiratory and cardiovascular conditions, especially in deprived communities.
- **NHS Strain**: Increased demand on emergency and chronic care services, particularly for asthma, COPD, and ischemic heart disease.
- **Economic Losses**:
- £18M/year in avoidable health costs.
- Productivity losses due to illness-related absenteeism.
- Reduced attractiveness for inward investment due to poor air quality metrics.
- **Social Inequality**: Vulnerable populations—children, the elderly, and low-income groups—bear disproportionate health risks.
- **Planning Setbacks**: Missed opportunity to align with Net Zero, inclusive mobility, and regeneration goals.
- **Prepared by:** [Public Health and Policy Research Analyst] [Date: 25 September 2025, UTC]

31. Conclusion: A Missed Opportunity Scotland Cannot Afford

The cancellation of Glasgow Line 1 represents more than the loss of a transport corridor—it is the forfeiture of a generational opportunity to transform urban mobility, public health, and inclusive growth across the East–West axis of Scotland's largest city.

Over the next 25 years, the absence of Line 1 will result in:

- **625 avoidable deaths** and tens of thousands of preventable illnesses
- **£450 million in lost health savings**, burdening NHS Scotland
- **£1.5 billion in economic uplift** and **£2.5 billion in regeneration leverage** left unrealised
- **100 million car journeys** not displaced, undermining Net Zero goals
- **30% transport coverage uplift in deprived areas** not delivered

These are not abstract figures—they represent lives, communities, and futures.

Glasgow Line 1 was designed to deliver clean air, connected neighbourhoods, and economic resilience.

Its cancellation risks entrenching transport poverty, escalating emissions, and weakening Scotland's commitment to climate justice and public wellbeing.

Delivering Line 1 is not just a transport imperative—it is a moral, economic, and environmental necessity.

The case for reversal is urgent, evidence-based, and aligned with Scotland's national strategies for Net Zero, public health, and inclusive growth.

32 Final Conclusion

Glasgow: Hydrogen-Enabled Very Light Rail (VLR) – Strategic Note

Purpose

To set out the strategic rationale for considering **hydrogen-enabled Very Light Rail (VLR)** as part of Glasgow's emerging rapid-transit propositions, including Clyde Metro, and to explain why this option warrants structured consideration at pre-feasibility stage.

Strategic Context

Glasgow faces a well-established set of challenges: poor air quality in key corridors, constrained road space, long-standing public health inequalities, and the need for visible, place-based regeneration aligned with Net Zero objectives. Previous heavy-rail and conventional tram propositions have struggled to progress at pace due to capital intensity, delivery risk, and long lead times.

Recent appraisal and policy developments—particularly the **softening of Green Book application**, increased emphasis on **health, regeneration, and permanence**, and the growth of Scotland's hydrogen economy—create a materially different context in which lower-cost, modular rail solutions merit reconsideration.

The Hydrogen VLR Proposition (What Is Different)

Hydrogen-enabled VLR combines three elements that are materially distinct from earlier proposals:

A) **Rail-based permanence at lower capital cost**
Very Light Rail offers steel-on-steel guidance, high ride quality, and long asset life, but with reduced axle loads, simplified civil works, and modular delivery. This directly addresses historic affordability and disruption concerns associated with conventional tram schemes.

B) **Zero-emission operation without continuous overhead electrification**
On-board hydrogen power (with or without limited electrification) removes the need for full OHLE, reducing visual impact, utility diversions, and consenting complexity—particularly relevant in dense urban corridors and sensitive streetscapes.

C) **Integration with Scotland's hydrogen strategy**
The approach aligns with Hydrogen Scotland ambitions by creating stable, local demand for green hydrogen, supporting production, storage, skills, and supply-chain development alongside transport delivery.

Why Glasgow Is a Strong Candidate

Glasgow presents a particularly strong early opportunity because:

1. **Corridor suitability** – Several east–west and orbital corridors exhibit demand profiles that exceed bus/BRT capability but fall below the threshold traditionally assumed for heavy tram or metro investment.
2. **Health and air-quality impacts** – Persistent exceedances and deprivation-linked health outcomes materially strengthen the case for rail-based modal shift when assessed over a 30-year horizon.
3. **Regeneration logic** – Fixed rail has demonstrably stronger place-shaping and investor-confidence effects than flexible modes, an increasingly relevant factor under rebalanced appraisal criteria.
4. **Delivery risk management** – Modular VLR enables phased deployment, demonstrators, and early wins within a single parliamentary term, reducing political and financial exposure.

Appraisal and Value-for-Money Considerations

Under a modern Green Book interpretation, hydrogen VLR performs strongly where appraisal properly captures:

- Long-term air-quality and public-health benefits
- Asset longevity and reduced whole-life replacement risk compared with bus-based infrastructure
- Regeneration certainty and land-use response
- Intergenerational value and carbon compliance beyond 15 years

Crucially, hydrogen VLR should not be assessed as a niche technology project, but as **core urban rail infrastructure** with an alternative power source.

Recommended Next Steps (Decision-Safe)

Ministers are **not** being asked to approve delivery, but to support:

1. Inclusion of hydrogen-enabled VLR as a formally defined option within early Clyde Metro / Glasgow corridor studies.
2. A short, proportionate pre-feasibility exercise to test costs, deliverability, and appraisal performance on one or two representative corridors.
3. Alignment of transport appraisal with Scotland's hydrogen and industrial strategies to avoid siloed decision-making.
4. **Key Risk (and Mitigation)**

Risk: The option is dismissed prematurely due to legacy assumptions about trams or hydrogen.
Mitigation: Ensure like-for-like appraisal against BRT and conventional tram options using consistent assumptions on asset life, health impacts, and carbon compliance.

While this report presents a compelling case for Glasgow Line 1, its projections raise important questions that policymakers and stakeholders must address before committing to such alternative transformative expensive investments, including any bus based urban solutions.

First, the mortality and morbidity figures—hundreds of deaths annually and thousands of illnesses—are based on modelling assumptions.

How robust are these estimates, and do they fully account for confounding factors such as socioeconomic status, healthcare access, and other environmental variables?

Similarly, the economic valuation of inaction, exceeding £500 million per year, relies on Value of Statistical Life metrics and cost-of-illness models. Are these figures universally accepted, or could alternative methodologies produce significantly different outcomes?

Second, the legality of framing transport investment primarily as a health intervention warrants scrutiny.

Does this approach align with statutory obligations under Scottish transport and planning law, it certainly highlights failure to comply with current WHO regulations and is ideal for a testing ground or test case for an “Ellas Law” type claim and how might it interact with procurement regulations and competition law if delivered via private-sector models like HTaaS?

Finally, the political implications cannot be ignored. If the report’s predictions prove overstated, the reputational and financial fallout for Glasgow City Council and the Scottish Government could be severe—especially given competing priorities for public funds. Conversely, failure to act could invite criticism for neglecting public health and climate commitments.

This tension underscores the need for transparent debate, independent validation of assumptions, and a clear governance framework before proceeding.

In short, Glasgow Line 1 may offer transformative benefits, but the scale of claimed impacts, the legal framing, and the potential political risks demand rigorous scrutiny.

Decision-makers must weigh not only the promise of innovation but also the accountability and credibility of the evidence underpinning this case.

NB.
We have completed a similar study for Line 2, West – East, and Line 3, Drumchapel Dasher with similar horrific results.

Subject to further funding, we will be doing a comparative study of the Light Metro lines when routes are firmed up.

We believe that the parameters for Glasgow Metro have been set too narrow and that these three significant Lines have been forgotten and not seen for what they are,

33 Glasgow Funding Roadmap 2026–2030

A summary of Glasgow's funding opportunities for 2026–2030, including key streams, lead agencies, and application deadlines and is not complete list @ 1st November 2025

Top Funding Streams & Lead Agencies

- Glasgow Communities Fund — Lead: Glasgow City Council
- Vacant & Derelict Land Fund — Lead: Scottish Government / Glasgow City Council
- Glasgow Wellbeing Fund — Lead: Glasgow City Council / NHS GGC
- Active Travel Infrastructure Fund (ATIF) — Lead: Transport Scotland
- EV Infrastructure Fund — Lead: Transport Scotland / Local Authorities
- Innovate UK – Net Zero Living — Lead: Innovate UK
- Great British Energy Community Fund — Lead: UK Government / Local Energy Hubs
- City Region Deal Enhancements — Lead: Glasgow City Region Cabinet
- Scottish Government Net Zero Grants — Lead: Scottish Government

Application Deadlines (Indicative)

Funding Stream	Lead Agency	Deadline
Glasgow Communities Fund	Glasgow City Council	Closed Apr 2025
VDL Fund	Scottish Govt / GCC	27 Jun 2025
Wellbeing Fund	GCC / NHS GGC	29 Oct 2025
ATIF	Transport Scotland	Early 2026 (TBC)
EV Infrastructure Fund	Transport Scotland	Summer 2026
Net Zero Living	Innovate UK	25 Jun 2025
GB Energy Fund	UK Govt	30 Sep 2025

Strategic Priorities & Next Steps

• Align bids with Net Zero, health, and regeneration goals
• Prepare Green Book-compliant business cases
• Engage stakeholders early for letters of support
• Build an application calendar for Q4 2025 and H1 2026 deadlines

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Transport in a silo

Pre-feasibility study

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Light Rail UK Team Nov 2025