



# Light Rail (UK) Group

H2, The Tram Fuel of the future



MRV3: 100 passengers x 1 Driver



Autonomously coupled 1 x Driver, 300 Passengers



WINNER OF THE YEAR  
WINNER OF THE YEAR  
WINNER OF THE YEAR



MRV3: 100 passengers x 1 Driver



HRT - New build, Old design, Abuse

A pre-feasibility study for *Triton Hydrogen*,  
by Mr James Harkins FCILT MTPS,  
*Chairman*, Light Rail UK Group,

Light Rail (UK). (A not for profit company) who are an association of Light Rail Consultants, Transport Engineers Politicians, Academics, Environmentalists and others who are commercial specialists in low cost, affordable & sustainable tramways  
[www.applrguk.co.uk](http://www.applrguk.co.uk)

A major Air Quality problem is Urban Transport Corridor Pollution, NEE, which need increasingly tighter climate control legislation and World Health Organisation (WHO) standards.

## ***Light Rail UK Group Believes in***

The proven success of current UK tramways

### ***Why Trams***

The widespread recognition within the UK and internationally of the benefits of light rail as an environmentally friendly form of mass transit

On average there is a modal switch of 25% - 32% resulting in lower road mileage with resultant cleaner air, Nottingham does not require LEZs etc.,

That electric buses can only be seen as an interim measure and other rubber wheeled vehicles despite their other (short term benefits) remain a source of significant particulate pollution arising from the friction between tyres and road surfaces while steel wheels running on steel rails create zero emissions at point of use.

Be fully accessible to all residents and visitors including those with reduced mobility to all Tram and shared Bus stops, Public Transport Pathways (PTP). Be mindful that we have an ageing population, and the network will be fully accessible, easy to understand and use successfully to supply the last/first mile door to door connectivity to planned Rail upgrades

A Tram Network will provide access to employment including industrial and logistics sites, Provision of cleaner air to schools and hospitals Sports & leisure including several stadia Heritage and tourism. A “Rochdale Pattern” of transit behaviour, “Hop on, Hop Off” supporting the 15 minute neighbourhood concept. Provide fixed links to other modes without building more unsuitable and unsustainable road with new but smaller housing d For public transport to become a force in dealing with urban congestion, carbon reduction, improving air quality and to be an attractive alternative to the car, it must be built quickly and operate affordably.

Some benefits:

- Light rail systems have proven track record
- Growing the public transport market
- Creating modal shift in some cases 32%
- Supporting regeneration , renewal and inward regeneration
- Assisting in the creation of a new urban framework
- An extremely green mode of transport
- Will drastically reduce the nations carbon footprint
- Can be used to re-engineer city districts
- Re-developments including denser housing without parking spaces.

## Air Quality

### A “Green Wash” Pollution hidden in Plain sight

There are two main Transport Corridor Pollutants (UTC).

Tail-pipe emissions, and Road, Tyre & Brake Dust (NEE), (Often Known as the “Oslo Effect”)

Defra Report July 2019 QUALITY EXPERT GROUP

This is a report from the Air Quality Expert Group to the Department for Environment, Food and Rural Affairs; Scottish Government; Welsh Government; and Department of the Environment in Northern Ireland, on non-exhaust emissions from road traffic.

The information contained within this report represents a review of the understanding and evidence available at the time of writing.

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mg PM <sub>10</sub> / km		Tyre	Brake
Cars	Urban	8.7	11.7
	Rural	6.8	5.5
	Motorway	5.8	1.4
LGVs	Urban	13.8	18.2
	Rural	10.7	8.6
	Motorway	9.2	2.1
Rigid HGVs	Urban	20.7	51.0
	Rural	17.4	27.1
	Motorway	14.0	8.4
Artic HGVs	Urban	47.1	51.0
	Rural	38.2	27.1
	Motorway	31.5	8.4
Buses	Urban	21.2	53.6
	Rural	17.4	27.1
	Motorway	14.0	8.4
Motorcycles	Urban	3.7	5.8
	Rural	2.9	2.8
	Motorway	2.5	0.7

mg PM <sub>10</sub> / km	Road abrasion
Cars	7.5
LGVs	7.5
HGVs	38.0
Buses	38.0
Motorcycles	3.0

Vehicle Aggregate types	Total urban PM10/Kms
Cars (urban)	27.9
Trucks	127.1
Buses	112.8

Each time a tyre rotates, it loses a layer of rubber about a billionth of a metre thick.

This works out to about four million million, million carbon atoms lost with each rotation.

A busy road with 25,000 vehicles travelling on it each day will generate around nine kilograms of tyre dust alone per kilometre.



*As more and more ICE vehicles are converted to Electric Vehicle (EV) the carbon based soot dust generated by tyres, brakes, air suspensions and road surface wear are now bigger contributor to particulate matter (PM's) in the air than vehicle exhaust systems*

The fight against Tail Pipe pollution has been virtually won with ICE engines being replaced by a range of EV & BEV at a cost of heavier vehicles and more Non-Exhaust Emissions (NEE) which are high in soot particles and heavy metals

Thus

NEE PM10 have increased from 29% in 2000 to 73% in 2016, (2.75% per annum)

NEE PM2.5 have increased from 26% in 2000 to 60% in 2016 (2.125% per annum)

NEE PMs Road Dust Suspension and downwind plume not included Affects roadside buildings inside up to 25 miles

153,000 respiratory deaths, mainly young & old British Thoracic Report

Figures show between 25% - 40% of deaths due to "Tail Pipe emissions"

(38,250 – 61,100 deaths) UK Government

Data from the UK national Atmospheric Emissions Inventory (NAEI)



### ***Why Aberdeen Harbour***

Hydrogen trams are a sustainable form of transport to enable Aberdeen Port to become Scotland's premier net zero port, offering world class facilities and services, at the heart of the nation's energy transition efforts.

Will give clean sustainable access to ETZ Ltd and allow the offshore wind, hydrogen, and wider green energy sectors to grow, while working to hit net-zero targets, creating thousands of north-east jobs. ETZ Ltd Bosses say direct access to the quayside is a "crucial requirement of potential investors", which is why St Fittick's is earmarked.

The tourism industry in North East Scotland is a significant contributor to the Scottish economy, according to VisitScotland, the tourism industry in Aberdeen, Aberdeenshire, and Moray generated £856 million in total spend in 2019.

The Scottish government reports that the tourism industry contributes around £6 billion to the overall GDP of Scotland, which is around 5% of the total GDP <sup>23</sup>.

### ***Very Light Rail***

The construction of a demonstration project in Coventry city centre of a Very Light Rail (VLR), a system involving light rail vehicles on much lighter rails compared to current tramways with the potential for dramatic reductions in construction costs, faster construction and less disruption.

The scope for further innovation in conjunction with hydrogen-powered trams with on board or overhead line or both in the case of Midland Metro, have the potential to transform the business environmental case for further developments of light rail (VLR) systems.

### ***Coventry Very Light Rail***

That early evidence available from the development of proposals for Coventry suggest it may be timely to identify and undertake initial scoping studies for new schemes and revisit potential schemes previously rejected on cost grounds. We have identified at least 85 such locations

That the potential of very light rail (VLR) technology now proven, there is scope for generating economies of scale plus new manufacturing and construction employment opportunities through the development of a sequence of schemes.

The go ahead of the very light rail (VLR) project in Coventry with the gathering of data and monitoring of progress from the outset so its implications for new schemes and reappraised schemes in Scotland and elsewhere can be realistically appraised.

The Hydrogen tram demonstrator vehicle coming into service at BCIMO Dudley could be used for this purpose either using on board or by wire or both

### ***Trams are Sustainable, No pollution at the point of use***

That Light Rail and Trams have a proven record of getting people out of their cars while producing zero emissions and particulates at point of use and that, in future, very light rail (VLR) offers significant potential for enabling these benefits to be realised on a significant larger scale especially in our smaller cities and towns.

A growing and more productive towns and cities, and an inter urban regional connectivity with economic growth and development through agglomeration. A direct benefit is a significant decarbonisation and boost of cleaner air, representing best value for money for the Taxpayer.

### ***Opens up Housing Development without major road building.***

That local authorities, with their detailed knowledge of population distribution, anticipated housing and industrial development and current infrastructure pressures are best placed to provisionally identify opportunities for the development of light rail and trams within their areas.

That it is unrealistic, given the current financial and other pressures which they face, to expect local authorities to acquire the in-house expertise needed to develop themselves, or oversee the commissioning of, business cases, detailed feasibility and engineering studies.

Delivering an integrated transport system will often involve initiatives that span local authority boundaries and mechanisms for coordination at regional levels are needed to help promote and deliver such schemes.

That expertise and funding for supporting the development of initial scoping studies through fuller detailed 'shovel ready' proposals often at Government short notice, should be available now to local and regional authorities who can identify realistic potential light rail and tram schemes.

That should new opportunities for the expansion of light rail and trams arise through environmental pressures and/or significant cost reductions through engineering innovations then significant economies of scale could be realised through a coordinated approach to light rail development at regional level.

That in addition to the Coventry proposals for a Very Light Rail project in a major city centre, there is a case for identifying an additional proof of concept for connecting suburban areas in a large town to the rail hub and town centre.

### ***TramTrain***

There is a significant potential, not hitherto fully understood, for suitable branch lines including the use of TramTrains capable of running at speeds over the heavy rail infrastructure to be used.

The implementation of proposals to extend the Manchester Metrolink to Bolton, Wigan, Heywood, Warrington, and Stockport. Government support for the development and evaluation of very light rail (VLR) and other innovations which may transform the business case for light rail and tram development.

## Where else can trams go

Scottish Government to collaborate actively with local transport authorities through a similar program to 'Restoring our Railways' scheme by offering support for scoping and evaluating light rail, tram, and very light rail schemes (VLR) and, where initial feasibility studies are promised to assist with the development of the business case and engineering studies.

In many areas there is a dearth of former or lightly used heavy rails available often however there are many former trunk roads which can be repurposed using VLR technology.

Since the end of World War 2 our Strategic Road Network [Trunk] has been improved to provide the- connectivity, efficiency, and wider economic benefits. Over this period, we have seen small trunk roads being rebuilt to three lane, dual carriageway standards.

In many locations a bypass has been built to relieve congestion and pressure on the bottle neck towns and dormitory areas. Eventually higher capacity motorways were built, with extra carriageway added until they in their turn have become saturated.

This has left a legacy of former trunk roads that are now underutilised, and one carriageway could be repurposed for other transport modes in connection with other developments such as park and ride facilities close to Motorway, Bypass junctions, and Railway Stations.

Many of these former trunk roads provide a direct and relatively unimpeded access to the business and commercial centres of the cities and could become ideal public transport corridors using clean and energy efficient vehicles such as Trams or smaller Very Light Rail according to the predicted demand.

This photo montage shows how one carriageway could be converted to a public transport lane and the remaining carriageway could be used for local traffic.



Ideally, where only rail traffic is required, traditional ballasted track could be used reducing the cost of laying the tracks, with embedded tram track only required at road junctions or where the route needs to be shared with local buses.

This, along with the use of battery energy storage with charging points or clean onboard generation, the city centre could

be wire free although not recommended for the whole route unless for the lighter vehicle options are used.

## **Modal Switch**

The analysis found that automotive manufacturers in the EU had disclosed agreements that would cover only 14% of lithium, 17% of nickel and 10% of cobalt that will be needed to meet their targets for 2030.

The shortage of materials such as computer chips, copper, aluminium, cobalt, and steel has led to fewer new vehicles being produced, which has resulted in more buyers turning to the used-car market. This has caused a surge in second-hand car prices.

The shortage of raw materials could further affect the supply and price of new vehicles entering the market.

The shortage of car parts already has left drivers waiting for months for repairs or having cars written off because replacement parts apparently cannot be found.

Traffic growth varies not only by scenario, but also by road type. The projections consider traffic growth for motorways, A-roads, and minor roads. In the Core Scenario, traffic on minor roads and A-roads is expected to grow by 21% and 20% respectively, while motorway traffic is projected to increase by 27% between 2025 and 2060.

Congestion (measured in delay per mile) is also projected to increase, with the average delay per mile projected to increase around 27% between 2025 and 2060. Motorways have the least delay, which rises from 4 seconds in 2025 to 10 seconds in 2060. The average delay on A-roads and minor roads is longer but rises by a smaller proportion (21 seconds to 29 seconds on A-roads, 30 seconds to 33 seconds on minor roads). National Road Traffic Projections 2022

We do not believe that this is the definitive future as we can already see that the high prices of owning and running personal transport in this mode will probably be on an opposite scale with rubber wheeled vehicles being prohibited from the Urban Transit Corridors by emerging Climate Change Legislation e.g. “Ella’s Law”, which now means that local authorities can be prosecuted for failing to ensure Clean Air and subsequent claims that will surely follow. and many more in the next 25 years as we will lose the Climate Change battle by continuing to favour this favoured mode

There is also the “No win – No Fee culture” effects to be seriously considered

## **Euro 7 Particulates**

Euro 7 introduces controls on ammonia, a cause of poor air quality in urban areas, and formaldehyde, a carcinogenic gas, for passenger cars. There are also tighter controls on the amount of brake and tyre dust that vehicles can produce in addition to the existing limits on particulate matter in their exhaust gases. Cars will also be tested under a wider range of conditions than before.

We ask the question of how we will be able to move our citizens around our cities and town, create and maintain employment opportunities, generate wealth to maintain our tax base and many other social issues

Long before planners realised it, Jacobs had realised the problem of “induced demand” that roads create. This is also known in effect as Jevons paradox. That

is, if you make something more abundant, the price of it will fall, and people will use it much more than they previously did. William Stanley Jevons was an English economist in the nineteenth century who looked at coal. Jevons noticed that when James Watt improved the efficiency of the steam engine, so that it did not need anywhere near as much coal to use, the result was not that demand for coal fell. Rather, it meant that running steam engines was much cheaper, so people did it much more. In a similar way, increasing the amount of road space does not lead to less congestion. Rather, it increases the number of cars.

The problem, Jacobs recognised, was not the cars themselves. “We blame automobiles for too much,” she wrote.

The problem was in fact the planning that designers, obsessed with the car, insisted on. “Highwaymen, traffic engineers and city rebuilders, again, face a blank when they try to think what they can realistically do, day by day, except try to overcome traffic kinks.” She pointed out that before the car was even invented, traffic jams of horses and carts sometimes snarled up the streets of London and left the streets encrusted with manure. Replacing that traffic with cars was actually a good way to improve the city.

## **Political**

The air quality issues that this country faces is essentially political. If you look at a city like Mumbai, “the most widely used form of transportation, are actually your legs. Most people walk. In some form or fashion. And yet if you look at how the city is being planned, it is as though the primary form of transportation is actually cars.” This is “the classic Mancur Olsen problem,” Mancur Olsen was an American political scientist who wrote about how exploitative governments arise. That is, in short, “a powerful organised minority will always trump the interests of the majority.”

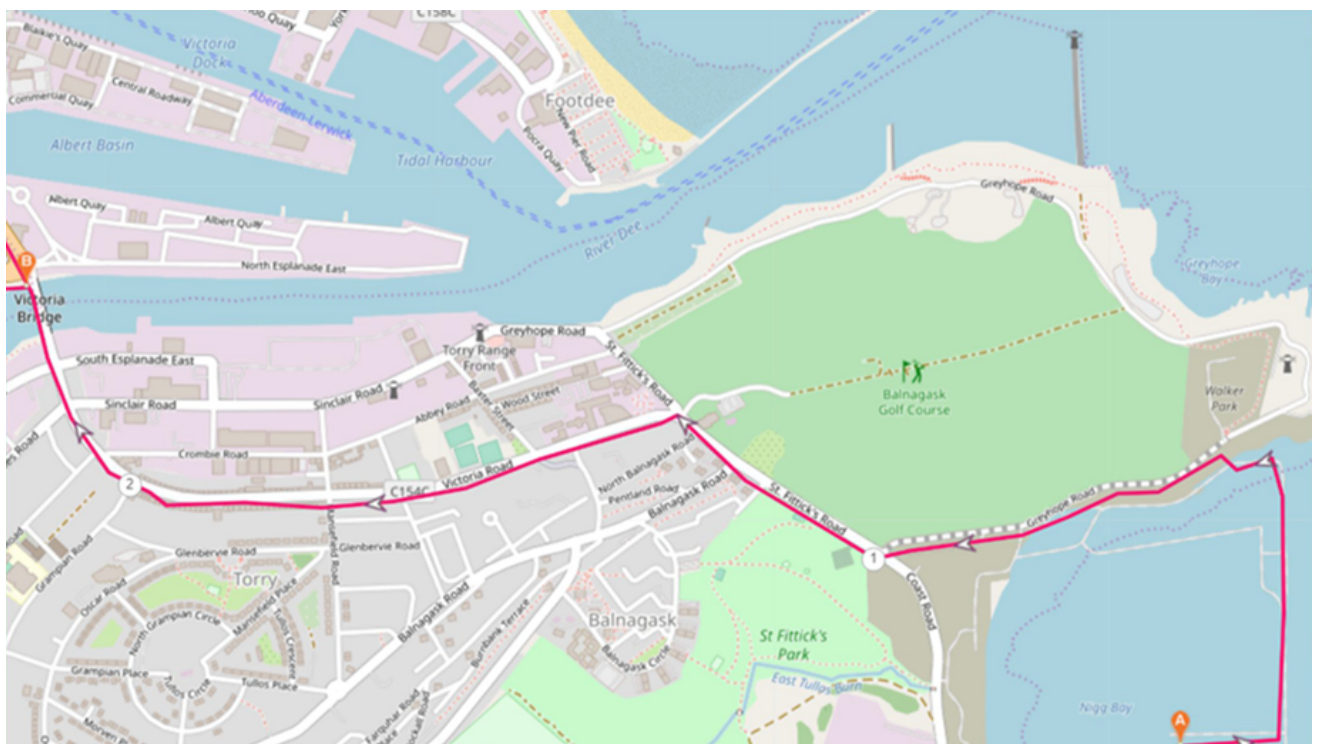
But rubber wheeled vehicles are the primary cause. “The primary source of anthropogenic NMHCs [non-methane hydrocarbons, or particulate matter] in Delhi was from traffic emissions,” according to one extensive study published in Faraday Discussions, the journal of the Royal Society of Chemists, in 2020.

And a powerful minority wants cars. (Buses provide the token public transport on the roads)

Map 1 The Route 3.80m/6.12 KM  
Aberdeen South Harbour Railway Station Via Bus Station Loop



Map 2 Shippside to Victoria Bridge







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The Route: Seaward Leg

Map 3 To Victoria Bridge via Bus Station Loop to Victoria Bridge





Map 4 Quay side to Coastal Road St Fittocks City direction double tracked



Map 5: Harbour Entrance  
Proposed Quay Entrance/exit. May vary as under construction at time of photograph



Map 6 Possible Depot site if available, adjacent to Nigg Golf Club



Map 7 203 Victoria Rd High density flats, Commuters.





Map 8 390 Victoria Road City, twin track, centre road running



Map 9 356 Victoria Road, Twin tracked, utilities appear to be under pavements or parking Marine Scotland, a major traffic generator



Map 10 Victoria Bridge City Bound Twin Track Gutter Running



Map 11 Victoria Street, Central reservation running, Reallocation of road space, Tram & Bus track sharing





Map 12 Central Business Area Central reservation running  
Reallocation of road space, Tram & Bus track sharing



Map 14 Central Business Area Central reservation running  
Reallocation of road space, Tram & Bus track sharing



Map 15 Bus Station Entrance Double Track  
(N.B. Single Loop through bus station or double track to next junction, turn left)



Map 16 Possible Interlaced trace, Line of sight, Enforcement of Hatch Box Required

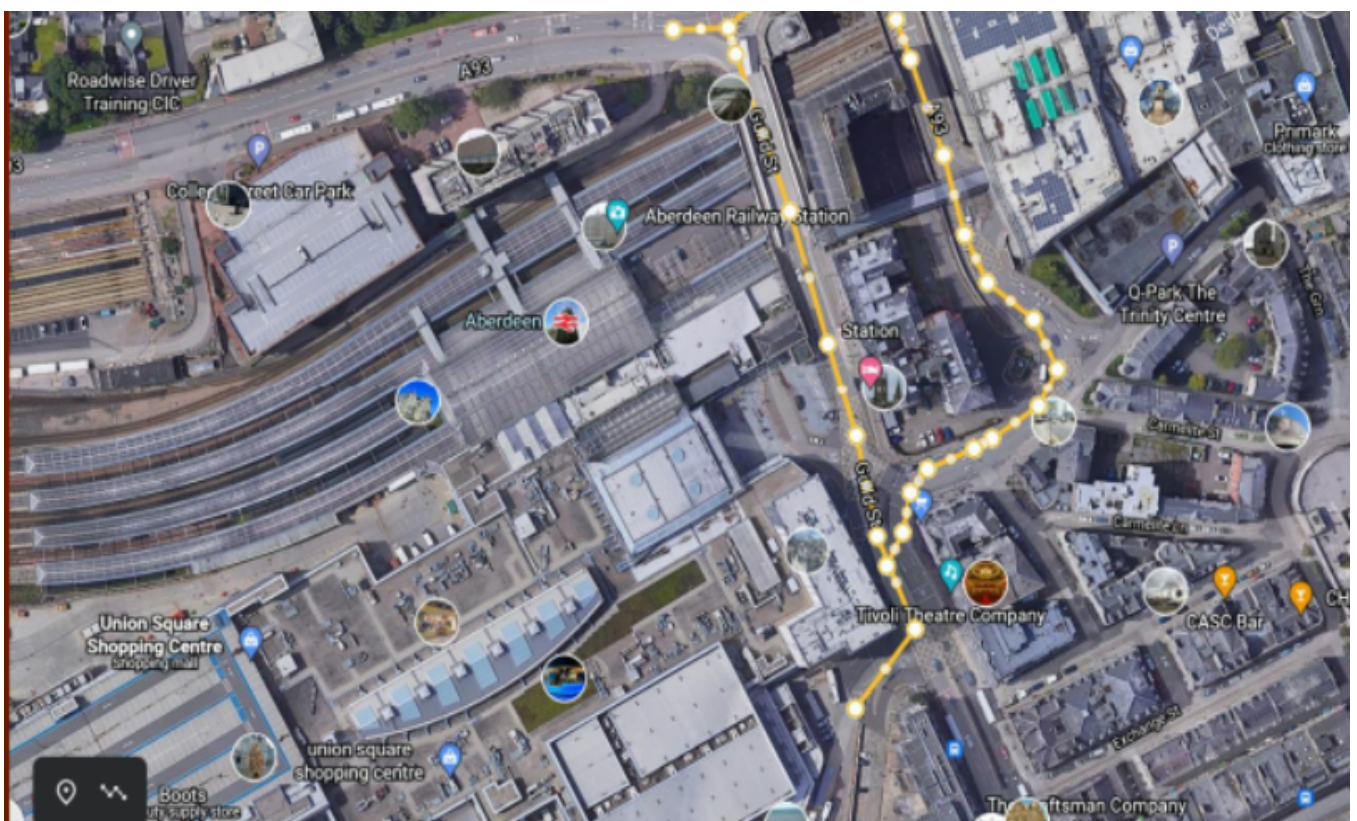




Map 17 Public Transport Exit/Entrance Guild Street. Compulsory purchase others side of the wall



Map 18 Central Loop, forming a city centre Tram Carousel (TC) for further tram routes





## **\*Scottish Government Hydrogen Policy Statement**

Published 21 December 2020

- ❖ Extracts from the above document and updated in red, to highlight a serious omission from that document and the Scottish Government's Hydrogen Policy Statement. We believe that these omissions are due to a mis reading of the earlier results of the Edinburgh Tram project phase 1 by Transport Scotland who withdrew the Tram option from the available developmental mix to Scotland's detriment. In conjunction with Triton Hydrogen and others in the existing supply chain who are prepared to invest in several million pounds to prime pump and correct this issue as discussed with Mr Stuart McKay, Hydrogen Scotland 19<sup>th</sup> Dec 2023.

### **❖ Policy Priorities: Hydrogen in Transport**

*Scotland has been an early adopter of hydrogen in transport, with Aberdeen being one of the first European cities to roll out hydrogen fuel cell buses. Over the past five years, more than £40 million has been successfully invested or earmarked for ground-breaking hydrogen transport projects.*

*We are now moving into a new phase. **which needs hydrogen trams reviewed and a demonstrator line, see above.** Having successfully demonstrated the technical viability of hydrogen in a range of transport applications **including trams**, our focus is turning to scaling-up the potential for hydrogen by linking together opportunities across sectors and transport modes and building Scotland's potential for innovation and supply chain growth*

*Cities and regions across Scotland, including Aberdeen, Glasgow and Dundee, **(between 800 – 1200 units required and release buses as feeder services based on the Wroclaw pattern)** are also now driving forward coordinated strategies to harness the opportunities for linking up transport demand, green energy generation and innovation in product developments in the application of fuel cells to a growing range of vehicles types and transport modes.*

*Scotland is well positioned to be a global destination for development and deployment of hydrogen technologies **in a tram based transport system***

## **A sustainable transport system**

Scotland's National Transport Strategy (NTS2) sets out four priorities for our transport system: reducing inequalities; taking climate action; supporting inclusive economic growth; and improving our health and wellbeing.

*In line with the sustainable travel hierarchy, our priority is managing or reducing demand for travel, and supporting active travel and public transport. Where this is not possible, we must support a swift transition to new, low and zero emission modes of transport **including Trams**. This will require a mix of technology and behavioural shifts, all underpinned by fast-paced innovation and commitment.*

*Supporting this shift is about much more than just reducing carbon emissions **including the hydrocarbon soot particles PM10s & PM2.5s associated with Non Exhaust Emissions, Defra Report August 2019**. It is also an opportunity to reimagine mobility's place in society and to drive forward investment in and growth of new industries, skills and the innovation needed to underpin this transformation **and achieve Minister Hyslop's target of reducing Scotland mileage by 28%-32% just through modal switch and thereby significantly cleaning the air in our main transport corridors.***

*Supporting this shift is about much more than just reducing carbon emissions. It is also an opportunity to reimagine mobility's place in society and to drive forward investment in and growth of new industries, skills and the innovation needed to underpin this transformation.*

## **Hydrogen in the Transport Sector**

*Investment in electric vehicles globally is planned to reach \$300 billion over the next 5 - 10 years. The UK's share of the global market for low emission vehicles is estimated at £240 billion a year by 2050. Global market for other low emission vehicle products and services, including exhaust retrofitting, batteries, motor components, battery recycling, hydrogen fuel cells and integration of vehicle systems into energy systems could be worth a further £110 billion to the UK.*

*Although often viewed as competing technologies, battery electric and hydrogen systems are in fact complementary and could both become cornerstone technologies for the electrification of transport. The Scottish Government is supporting targeted investment in both technologies **but omitting street running trams***

*The Scottish Hydrogen Assessment indicates that the transport sector, alongside industry, will most likely form the initial areas of high demand for hydrogen in Scotland and could underpin a market of sufficient size to enable low-cost hydrogen production, with fuel cell markets developing or emerging in areas such as HGV's, buses, trains **trams** and shipping.*

*Hydrogen is already used internationally as a zero emission fuel for hydrogen fuel-cell electric vehicles (FCEVs) including passenger cars, **trams** buses, trucks, trains, and industrial machinery such as forklifts.*

*There are a rising number of Hydrogen Tram systems in service with more coming on stream*

### **Overlooked opportunities**

*Scotland now has an opportunity to support and strengthen its capabilities, encouraging the emergence of new hydrogen specialisms and commercial investments. Building on the strength of Scotland's early adopter and demonstration, the integration of hydrogen into the transport system at greater scale could also support the emergence of a local and regional markets for investment in green hydrogen.*

### **Future proofing**

The next step

Get Good Advisors – challenge them, stick with them! start public consultation early  
Get a “well-kent” local Public Face for the project

Be willing to revise the route to support developments Get the bus, rail and highway authorities on side Hydrogen Tram.

Achieving a sensible cost – benefit ratio Gaining public support Dealing with the existing built environment Achieving design quality

Rescheduling the traffic priority, Balancing where possible, the wants of the motoring lobby with the needs of the city

The Development of this modest circulator could form the basis of extensions to the rest of the waterfront development as it is developed.

As regeneration picks up the tramway should be extended. It is suggested that some six simple bogie trams could be acquired and using simple form construction the tramway could be constructed and vehicles acquired for <£10M.per track KM.

Think of this as a ‘Starter Line’ Inexpensive does not have to mean cheap-and-nasty

***Light Rail UK Group further believes.***

1. Identification of a potential further VLR prototype scheme in Scotland.
2. Pre-feasibility scoping and initial appraisal of potential schemes to include:
3. A Hydrogen VLR demonstrator/starter line Aberdeen Harbour South to Aberdeen Railway Station
4. A feasibility study of upgrading the use of the central reservations of the A92 Brig o' Dee to the Brig o' Don
5. A feasibility study of upgrading the use of the central reservations of the A944/A9119 Westfield to Aberdeen
6. Zebra Buses should only be considered interim only and not long term, a sort of bionic duckweed, which is usually different to that, in that it promises something transformational different, then when you examine it, does not hold water.
7. Tritonex Nano Polymer coating eliminates all leakage of Hydrogen, tested to 1800 bar pressure enabling Hydrogen to be stored or with lighter containers, used onboard vehicles.

*NB. A living document, work in progress Not finished.*