

From the 1832 Horse pulled Tramway to 21th Century Light Rail Transit/Light Metro Rail - a short History of the Evolution in Pictures

By Dr. F.A. Wingler, September 2019



Animation of Light Rail Transit/ Light Metro Rail

INTRODUCTION:

Light Rail Transit (LRT) or Light Metro Rail (LMR) Systems operates with Light Rail Vehicles (LRV). Those Light Rail Vehicles run in urban region on Streets on reserved or unreserved rail tracks as City Trams, elevated as Right-of-Way Trams or Underground as Metros, and they can run also suburban and interurban on dedicated or reserved rail tracks or on main railway lines as Commuter Rail. The invest costs for LRT/LMR are less than for Metro Rail, the diversity is higher and the adjustment to local conditions and environment is less complicated.

Whereas Metro Rail serves only certain corridors, LRT/LRM can be installed with dense and branched networks to serve wider areas.

In India the new buzzword for LRT/LMR is “**METROLIGHT**” or “**METROLITE**”.

The Indian Central Government proposes to run light urban metro rail ‘**Metrolight**’ or **Metrolite**’ for smaller towns of various states. These transits will operate in places, where the density of people is not so high and a lower ridership is expected. The Light Rail Vehicles will have three coaches, and the speed will be not much more than 25 kmph. The Metrolight will run along the ground as well as above on elevated structures. Metrolight will also work as a **metro feeder system**. Its cost is less compared to the metro rail installations. In addition to less capital cost, the operation and maintenance cost of Metrolight would also be less making the system more viable.

Seeing the success of metro rail in India, several other cities with a lower projection of ridership are also aspiring for a rail-based mass rapid transit system, which could be fulfilled by the light urban rail transit called 'Metrolight' or “Metrolite” with lower capacity at much less cost. To implement the ‘Metrolite’ system in smaller cities, the Central Indian Government will provide financial assistance to the states.

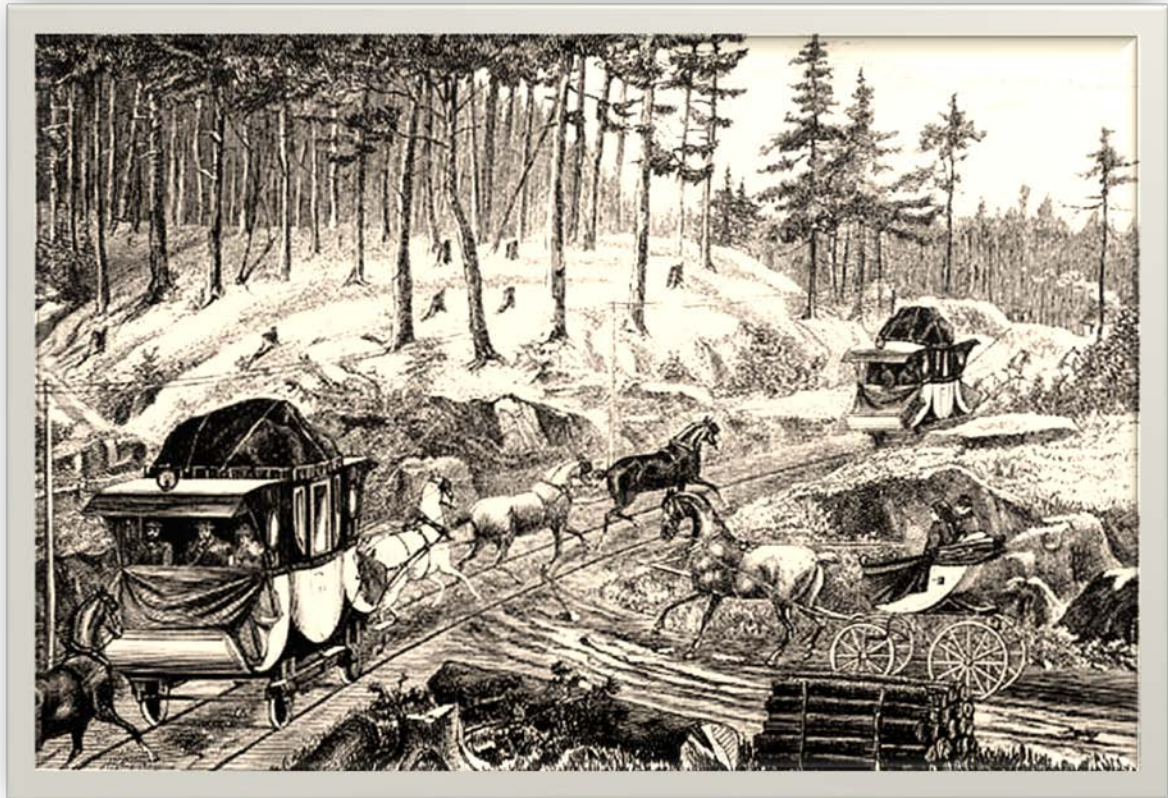


Light Metro LRV at Huston Texas, USA

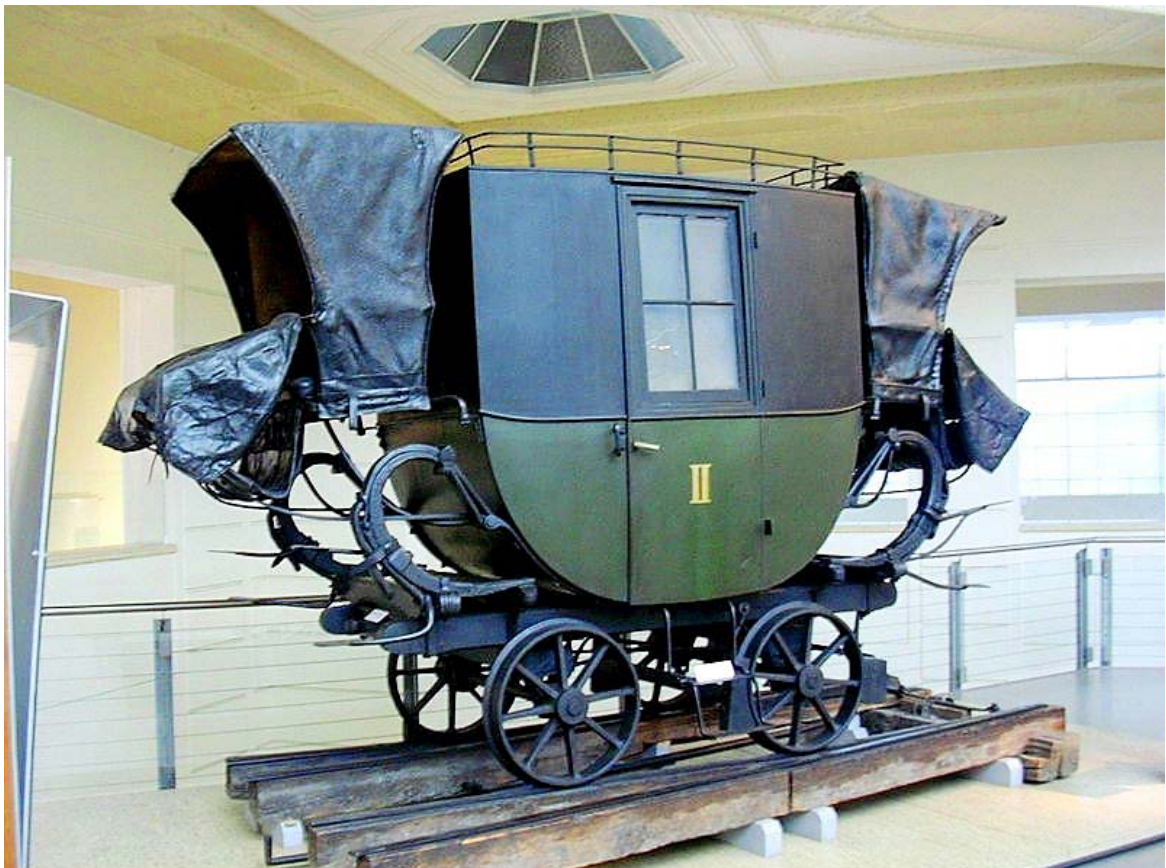
EVOLUTION OF LIGHT RAIL TRANSIT - LIGHT METRO RAIL:

It started with horse drawn street cars. The first horse-drawn streetcar service in the world started 1807 by the [Swansea and Mumbles Railway](#) in [Wales](#), using specially designed carriages on an existing tramline built for [horse-drawn freight dandies](#). Fare-paying passengers were carried on a line between [Oystermouth](#), [Mumbles](#) and [Swansea Docks](#) from 1807. The [Gloucester and Cheltenham Tramroad](#) (1809) carried passengers, although its main purpose was freight.

The evolution of Light Metro Rail (LMR) or Light Rail Transit (LRT) for public passenger transport continued in 1832 in Austria with the public passenger transport service on the 1927 opened horse drawn light railway from Budweis to Linz and further to Gmunden in Austria. The overall length had been 196 km, the gauge 1106 mm. It had served original for the transport of salt. Later the horse light railway had been partially converted to steam locomotive traction.



The "Cradle" of public interurban Light Rail Transit from 1832 in Austria
 Pict.: Source Wikipedia



2cnd Class Carriage of Budweis-Linz-Gmunden Horse Light Railway
 Pict.: Source Wikipedia



Remains of Budweis-Linz-Gmunden Horse Light Railway Track;

Pict. Source Wikipedia

The horse-drawn city tram (horse-car) became in the 19th century the early form of public rail transport in cities. It developed out of industrial haulage routes, using the newly improved iron or steel rails or 'tramways'. The horse-cars were local versions of the stagecoach lines and picked up and dropped off passengers on a regular route, without the need to be pre-hired. Horse-cars on tramlines were an improvement over the horse drawn omnibus, as the low rolling resistance of metal wheels on iron or steel rails (usually grooved from 1852 on) allowed the animals to haul a greater load for a given effort than the omnibus, and they gave a smoother ride. The horse-drawn street-car combined the low cost, flexibility and safety of animal power with the efficiency, smoothness and all-weather capability of a rail right-of-way.

In spite of its early start, it took many years for horse-drawn streetcars to become widely acceptable across **Britain**; the American George Francis Train first introduced them to Birkenhead in 1860 but was jailed for "breaking and injuring" the highway, when he next tried to lay the first tram tracks on the roads of London. An 1870 Act of Parliament overcame these legal obstacles by defining responsibilities, and for the next three decades many local tramway companies were founded, using horse-drawn carriages until replaced by cable, steam or electric traction. Many companies adopted a design of a partly enclosed double-decker carriage hauled by two horses. The last horse-drawn tram was retired from London in 1915. Horses continued to be used for light shunting well into the 20th century. The last horse used for shunting on British Railways was retired on 21 February 1967 in Newmarket, Suffolk.

In the **United States**, the very first streetcar appeared on November 26, 1832, on the New York and Harlem Railroad in New York City. The cars were designed by John Stephenson

of New Rochelle, New York, and constructed at his company in New York City. The earliest streetcars used horses and sometimes mules, usually two as a team, to haul the cars. Rarely, other animals were tried, including humans in emergency circumstances. By the mid-1880s, there were 415 street railway companies in the USA operating over 6,000 miles (9,700 km) of track and carrying 188 million passengers per year using horse-cars. By 1890, New Yorkers took 297 horse-car rides per capita per year. The average street car horse had a life expectancy of about two years.

In 1861, Street Railway horse cars in **Canada** replaced horse driven omnibuses as a public transit mode in Toronto. Starting in 1892, electric streetcars emerged in Toronto and by 1894 operating horse-cars stopped its services.

Europe saw a proliferation of horse-car use for new city tram services from the mid-1860s, with many towns building new networks:



1896 Horse drawn Street Car at Heidelberg, Germany

Many large metropolitan lines lasted well into the early twentieth century. New York City had a regular horse-car service on the Bleecker Street Line until its closure in 1917. Pittsburgh, Pennsylvania, had its Sarah Street line drawn by horses until 1923. The last regular mule-drawn cars in the US ran in Sulphur Rock, Arkansas, until 1926 and were commemorated by a U.S. postage stamp issued in 1983. Toronto's horse-drawn streetcar operations ended in 1891. In other countries, animal-powered tram services often continued well into the 20th century: The last mule tram service in [Mexico City](#) ended in 1932, and a mule tram in [Celaya, Mexico](#), survived until 1954 (Source Wikipedia).

Horse-cars were largely replaced by electric-powered streetcars following the invention by Frank J. Sprague of an overhead trolley system on streetcars for collecting electricity from overhead wires. His spring-loaded trolley pole used a wheel to travel along the wire. In late 1887 and early 1888, using his trolley system, Sprague installed the first successful large electric street railway system in Richmond, Virginia. The hills of Richmond included grades of over 10% being long a transpiration obstacle, were an excellent proving ground for

acceptance of the new technology in other cities. Within a year, the economy of electric power had replaced more costly horse-cars in many cities around the globe. By 1889, 110 electric railways incorporating Sprague's equipment had been begun or planned on several continents.

Before electrification, the first mechanical trams were powered by steam. Generally, there were two types of **steam tram**. The first and most common had a small steam locomotive (called a tram engine in the UK) at the head of a line of one or more carriages, similar to a small train. Systems with such steam trams included Christchurch, New Zealand; Adelaide, South Australia; Sydney, Australia and other cities in New South Wales; Munich, Germany (from August 1883 on); British India (Pakistan) (from 1885) and Dublin with the Dublin & Blessington Steam Tramway (from 1888) in Ireland. Steam tramways also were used on the suburban tramway lines around Milan and Padua; the last Gamba de Legn ("Peg-Leg") tramway ran on the Milan-Magenta-Castano Primo route in late 1958.

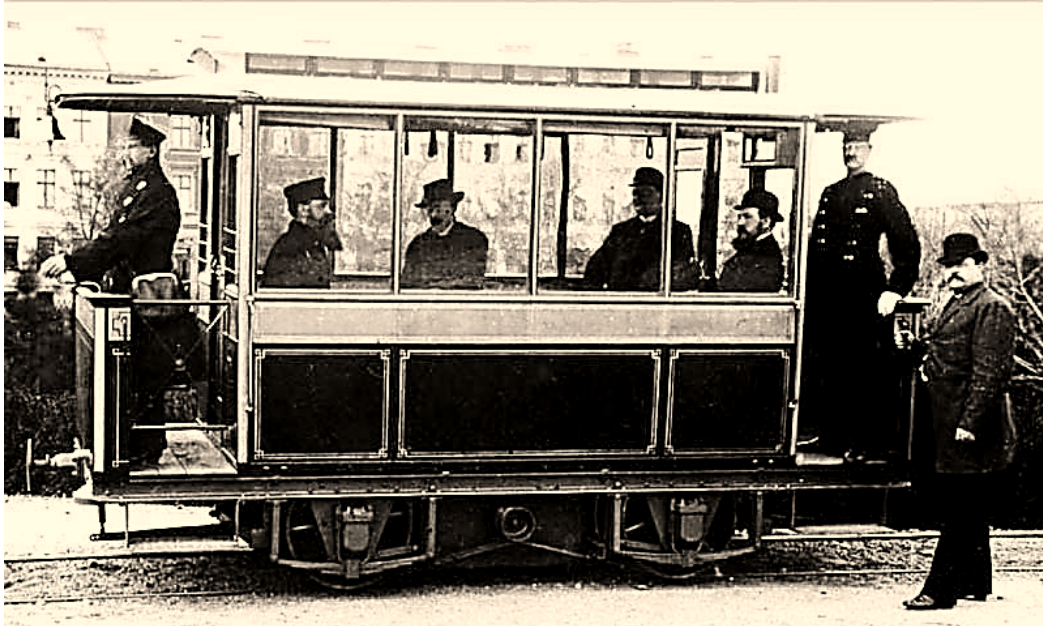
The other style of steam tram had the steam engine in the body of the tram, referred to as a tram engine (UK) or steam dummy (US). The most notable system to adopt such trams was in Paris. French-designed steam trams also operated in Rockhampton, in the Australian state of Queensland between 1909 and 1939. Stockholm, Sweden, had a steam tram line at the island of Södermalm between 1887 and 1901. Rotterdam in Netherlands operated a wide network of suburban steam trams.

Tram engines usually had modifications to make them suitable for street running in residential areas. The wheels, and other moving parts of the machinery, were usually enclosed for safety reasons and to make the engines quieter. Measures were often taken to prevent the engines from emitting visible smoke or steam. Usually the engines used coke rather than coal as fuel to avoid emitting smoke; condensers or superheating were used to avoid emitting visible steam. A major drawback of this style of tram was the limited space for the engine, so that these trams were usually underpowered. Steam tram engines faded out around 1890s to 1900s, being replaced by **electric trams**. (Source Wikipedia).



Street Steam Tram in Germany, at around 1900 at Brühl; Germany

The first continuously operated electric street tramway in Germany had been the Lichterfelde tramway at Berlin from 1891 with Siemens electric traction technology:



Berlin Lichterfelde electric City Tram from 1891

Electric City Trams conquered begin the 20th Century nearly all major cities in the world.

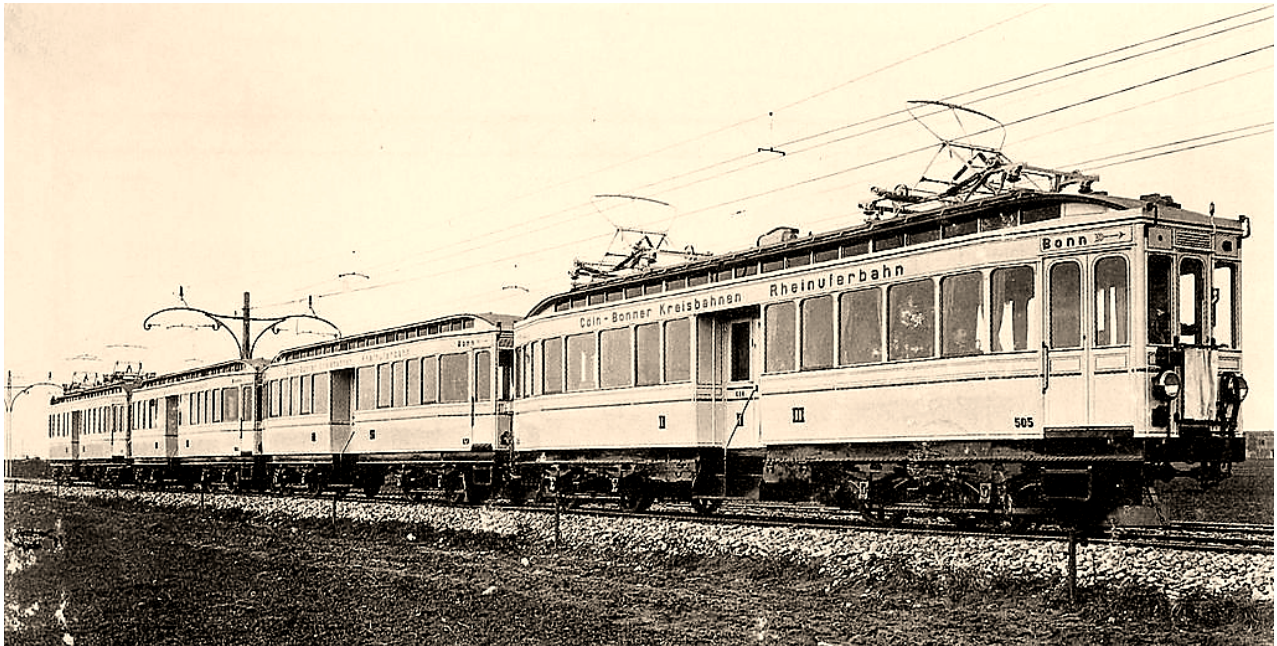
From 1900 to 1916, a large network of electric Interurban lines with streetcar-like light electric self-propelled railcars have been constructed in the **United States**, particularly in the states of Indiana, Ohio, Pennsylvania, Illinois, Iowa, Utah, and California. with streetcar-like light electric self-propelled railcars. Some Interurbans run as fast as 120 kmph.

In USA however, by 1930, most interurbans were gone, with few surviving into the 1950s. Oliver Jensen, author of American Heritage History of Railroads in America, commented that "...the automobile doomed the interurban whose private tax-paying tracks could never compete with the highways that a generous government provided for the motorist" (Source Wikipedia):



Ohio Interurban from 1908

In Germany, a popular and far advanced Interurban and still in operation is the Cologne-Bonn Rheinuferbahn from 1891, running from centre to centre of both towns along the banks of the River Rhine, nowadays integrated in the public rail transport schemes of the cities Cologne, Bonn, Siegburg, Bad Honnef and Godesberg:



Cologne-Bonn Interurban 100 kmph Express LRV from 1908; Pict. by Siemens

Worldwide, in the mid of the 20th Century electric city trams declined in many cities. Many tram systems were disbanded and replaced by buses, automobiles or [rapid transit](#)s. But in several Middle European countries, in Switzerland, Austria, Germany, Netherlands, Sweden, some East European countries and Turkey City Street Trams survived.

A famous City Tram running in Kolkata in India had a late survival:



Kolkata City Tram Survival in India

In the last decades, electric City Trams resurrected worldwide with innovative and smart Light Rail Vehicles as integrated parts of public transport systems for Urban Mobility. And even in modern megacities in USA, France and Saudi Arabia, which have never seen a city tram, new smart and innovative Light Metro Rail public transport has been installed. The world market for LRV, LRT and LMR is fast growing.

In the last 6 decades, in many German Cities the street tramway mutated to a chimera of Street and Underground Light Rail Transit (LRT) or Light Metro Rail (LMR). In centers of towns the street tramway track and stations had been transferred under the streets in tunnels to run as a so-called **“U-Bahn”**.

Nowadays, **LMR German Cities** a predominant public transport mode for Urban Mobility. It evolved from the last century traditional city tramways or street cars:

- Urban, the Light Rail Vehicle, LRV, run either underground as “U-Bahn” or on ground level as City Tramways;
- suburban, they run on dedicated/reserved tracks at grade as Light Rail Transits, LRT;
- interurban, they can run on main railway lines sharing the track with commuter rail, regional express trains, express trains and freight trains.

Thanks modern thyristor technology, the LRV can run seamless and smooth under different voltages and DC/AC systems.

Forerunners are the cities of Dortmund, Karlsruhe, Rastatt, Bruchsal, Heilbronn, Freudenstadt, Ludwigshafen, Mannheim, Heidelberg, Darmstadt, Cologne, Bonn, Siegburg, Bad Godesberg, Nürnberg and Berlin. India can learn from those shining samples. The LMR/LRT provide for commuters a seamless journey from one city center to the other center. Karlsruhe is leading with a dense and branched network, a symbiosis of urban, regional suburban tram and interurban inter-city Mainline Tram-Train.



City Tram/Light Rail Transit/Light Metro Rail/interurban Tram-Train Symbiosis at Underground (U-Bahn) Station of Cologne, Germany



City Tram/Light Rail Transit/Light Metro Rail/interurban Tram-Train
Symbiosis at Grade on reserved Track at Cologne, Germany



City Tram/Light Rail Transit/Light Metro Rail/interurban Tram-Train
Symbiosis on City Road at Cologne, Germany



City Tram/Light Rail Transit/Light Metro Rail/interurban Tram-Train
Symbiosis on Main Railway Line between Cologne and Bonn, Germany



Dual Voltage (750 V DC and 15 kV 16 2/3 Hz AC) LRV City-
Tram/interurban Tram-Train starting from Karlsruhe Main Railway Station
for a run through the City Centre and further on the Main Railway Line to
the Heart of the 149 km far City Forbach



Karlsruhe LRT Tram-Train running on Main Railway Line under high AC Voltage



Shanghai LRT CITADIS City Tram on reserved track and Shelter Station; China



LRV Vehicles operating on the Portland MAX Light Rail Transit, LRT, Network; USA

Portland in USA most progressive with innovative and smart schemes with integrated multimodal public urban and suburban transport for Urban Mobility as a Service, (MaaS):



Modern Street Car LRV in Portland, USA



Innovative ALSTOM LRV Citadis Tram



CAF Design for modern Light Rail Vehicle, LRV, for Light Rail Transit



Shelter Platform for LRT with Alstom Citadis X05 LRV; Caen, France – an example for an economical Solution for Indian Towns with less Ridership for much less Costs?

Light Rail Transit or Light Metro Rail is a feasible solution for cities with low or middle income population, and can be connected with Bus Mass Transit (BRT) and on-Demand private Bus Operatoion.

Adis Abeba in Ethiopia introduced successfully a Light Rail Transit:



Addis Ababa Light Rail Transit on reserved Track with Shelter Station; Pict. by Aleksandra Prodan

The major Swiss Cities Zurich, Bern, Basel and Geneve, and as well the second largest town in Austria Graz have decided not to go for Metro Rail and not to dig the City Tramway Lines underground. The cities operate a dense branched City Tram Network. In Zurich, in one can find always a tramway line in a perimeter of 300 m. Such a dense areal public transport service will be not possible with Metro Rail, that will serve only special corridors.



Dense and branched public Transport with Meter Gauge City Trams at Zurich, Switzerland

Urban, suburban and interurban LRT or Light Metro Rail run in Europe on 2 ½ feet (760 mm) and 950 mm Narrow Gauge, on Meter Gauge and on 1435 mm Standart Gauge (Italy, Austria, Switzerland, Germany and Spain). They can negotiate steep gradients. In Gmunden, Austria, the tram negotiates a gradient of 1 in 10, only by adhesion:



Gmunden Meter Gauge Tram negotiating a Gradient of 1 in 10; Austria



FEVE interurban LRT Commuter Train on Meter Gauge, North Spain



Stadler 950 mm Narrow Gauge LRV for Appullo Lucane LRT Railway (FAL)
on reserved Track; South Italy



Waldenburg 760 mm suburban LRT, Canton Basel, Switzerland

Nowadays, Light Rail Vehicles and Light Rail Transits can also run in towns as City Tramways without a catenary. With the **Alstom APS Technology** (Alimentation par Aesthetic Power Supply), the vehicle takes up the electric supply from a middle third power rail (third rail feeding technology), which switches section-wise on and off according to whether a tram is passing over them with a transponder, thereby eradicating any risk to other road users.

The Catenary-free Tramway and Light Rail Transit operation is service proven. APS is a highly reliable catenary free power system, that reduces the footprint of light rail lines and preserves the aesthetics of urban environments. Cities planning a tramway can today preserve their historical heritage and urban environment by dispensing with obtrusive overhead contact lines. Alstom's APS ground-level power supply system is a proven alternative with equivalent performance, which is currently operating in seven cities on three continents, and which offers safe and reliable electric power to trams and LRV, whether in short catenary-free sections or along the entire line:

The system is currently operating in revenue service in the French cities Bordeaux (2003), Angers (2011), Reims (2011), Orleans (2012), Tours (2013) and in Dubai, Emirates, opened Nov. 2014.



Doing away with Catenary: ALSTOM Catenary free Citadis APS (Alimentation par Aesthetic Power Supply) City Tram at Bordeaux, France on reserved LRT Rail Track



Shelter Platform Station with horizontal Platform Screen Doors of Dubai's Catenary free Light Rail Transit Metro; ALSTOM APS Technology

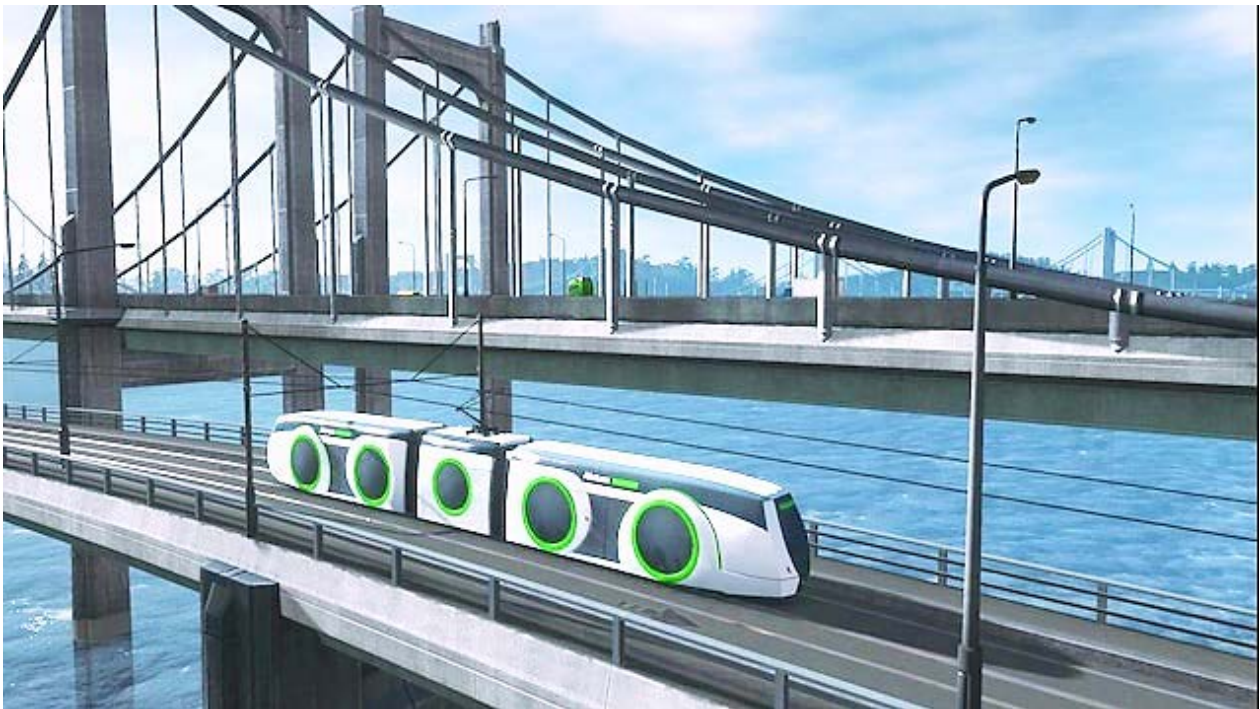


Dubai ASP Light Rail Tram on Mix of reserved and unreserved Track



ASP Light Rail Tram at Dubai with Shelter Station on reserved Track

To make trips around the city easy, a new innovative and futuristic concept in LRV, called the Alstom Loop train-tram, has been developed:



Animation of futuristic on Demand autonomous Alstom Loop Train-Tram.