International Association of Public Transport
Union Internationale des Transports Publics
Internationaler Verband für öffentliches Verkehrswesen
Unión Internacional de Transporte Público

Trolleybus Working Group
Core brief on
Technical evolution of trolleybus Panorama of the most promising trends

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Better mobility for people worldwide

CB Structure

Global and Urban Conceptions Challenge

Trolleybus for the future – take a dare

Major benefits of Trolleybuses

General approach.

Technical conceptions. Current and future developments.

Electrical (vehicle and overhead)

Hybrid Trolleybus

Mechanical

Trolleybus an integral part of city's public transport system.

Global and Urban Conceptions

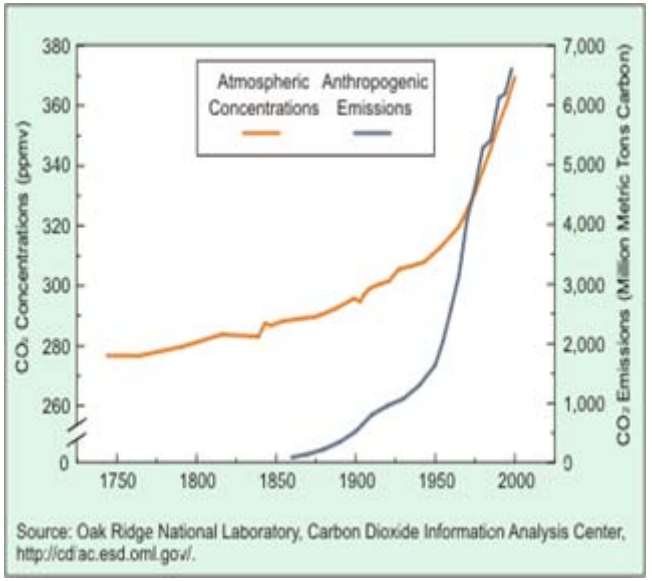
Fossils finiteness

It has become clear that the hydrocarbon fossil fuels will run so low or exploration and extraction costs will likely increase significantly

Global and Urban Conceptions

Climate Changing and GHG

Official acceptance of climate change predictions means all planning decisions will need to include solutions to reduce greenhouse gas (GHG) emissions.

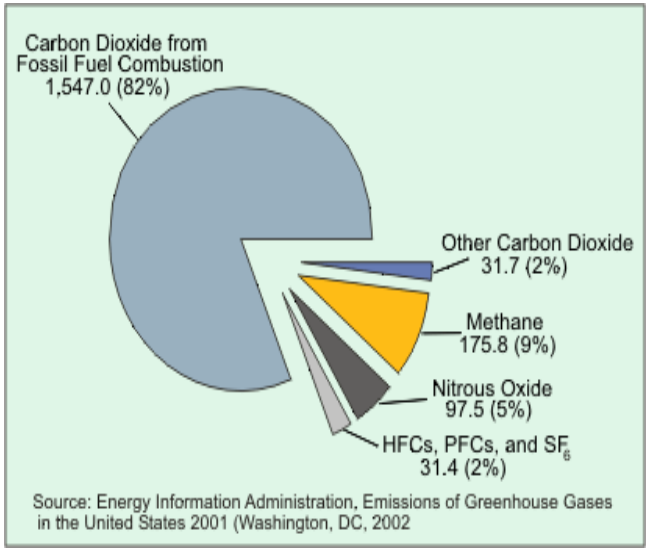


Global and Urban Conceptions

Urban environment and human health

In developed countries, respiratory ailments brought by pollutants of **toxic by-products of combustion** engine constitute the fourth leading cause of death.

Noise is also a pollutant. Exposure to noise above 85 decibels can cause hearing loss.



Global and Urban Conceptions

Urban mobility and congestion

Congestion makes cities unattractive places to live and work in.

Urbanization and the increasing mobility demand in urban areas take public transport as a 'miraculous escape'.

Global and Urban Conceptions

So it is clear to date

Paradigm of transportation must be shifted in a favour of energy efficient, global and urban environmentally hazardless and health non-influenced implementations

There is a very real chance to execute words to deploy a crucial modal shift in urban transportation.

Trolleybus for the future – take a dare

Back to the future?

Trolleybus invented in the late 19th century is an electric vehicle which draws their electricity from overhead wires.

Trolleybus for the future – take a dare

Major benefits of Trolleybuses

They are the most energy efficient on-road vehicles.

Trolleybuses use **pure electricity** - the 'fuel' of the future because of its **flexibility**, its **efficiency** and its **cleanliness**.

It can be, and will have to be, **sourced from a wide variety of alternatives** that are mostly impractical for direct use in vehicles.

Trolleybus for the future – take a dare

Major benefits of Trolleybuses

They release no local pollution. Electric traction is very environmentally appealing because

it is the only way to deliver zero emissions where it counts - **on the urban streets at the point of use**.

Trolleybus for the future – take a dare

Major benefits of Trolleybuses

They are quiet and smooth as they have rubber wheels instead of the noisy steel on steel of the tramway.

Trolleybus **lifespan is about twice longer** then for diesel buses because of no on-board engine producing vibration.

Trolleybus for the future – take a dare

Major benefits of Trolleybuses

The reduced capital and operational costs is cheaper than for diesel buses to date,

let alone a future where the costs of diesel are accelerating in only one direction

and note that electricity can be supplied from different kind of sources including renewable ones.

Trolleybus for the future – take a dare

Major benefits of Trolleybuses

They are lighter and whole system interface installation is less expensive **than for trams** .

Trolleybus for the future – take a dare

Major benefits of Trolleybuses

They can be hybridised to provide autonomous run with on-board battery storage or generating units. Hybrid Trolleybuses can be 100% independent of the overhead wires.

Accidents, planned maintenance, double parkers, etc. can all be bypassed without difficulties.

Hybrid trolleybuses can be widely used to extend routs and eliminate complex overhead cross-sections.

Trolleybus for the future – take a dare

Major benefits of Trolleybuses

The trolleybus system can be rapidly installed with minimal interference into the urban landscape.

State-of-the-art trolleybuses represent an attractive, innovative, environmentally friendly, high-value-for-money, transit solution that can be implemented quickly and cost effectively today.

General approach.

Worldwide trolleybus technology has kept pace with

tram developments, by sharing the same electrical control packages, and with

bus developments, including bi-articulation and low floors, where trolleybuses can, with

hub motors, achieve completely low level floors and wide aisles.

General approach.

Modern overhead wiring design has considerably reduced visual impact and greatly increased collection reliability

Off-wire ability of hybrid trolleybuses has become standard, using small diesel units or improved traction batteries to sustain service in areas regarded as sensitive to wiring intrusion

General approach.

LYON

ROME

General approach.

Guided systems

French initiatives in Nancy, Caen and Clermont-Ferrand use rubber tyred bi-articulated vehicles that use a **central rail as guidance**

General approach.

Guided systems

Optical guidance system opened in Castellon, Spain, the first stage of an extensive network

Cities like Clermont-Ferrand, Rouen, and Bologna have chosen the optical guidance system on some of their electric or thermal engine bus and tram-bus lines

General approach

Rapid Transit schemes

using **segregated roadways** have proliferated since the pioneer trolleybus system in **Quito, Ecuador** demonstrated the ability of trolleybuses to move over 250,000 passengers a day over a 11.2 km route.

RTS opened in Merida and Barquisimeto in Venezuela

General approach

Stations / Stops

Trolleybus networks are true alternatives to trams at lower cost, with **architecturally impressive 'stations'** as on the Merida system that would do justice to the most prestigious railway.

Technical conceptions. Current and future developments.

There is a particular technology in use the world over, backed by a well-established industry.

Electrical (vehicle and overhead)

Mechanical

Electrical (vehicle and overhead)

Create higher efficiency components

- Increase electric motor power density per kilogram
- Develop higher voltage system to allow power wire cross section to be reduced and hence total system weight
- Hook-up most trolleybus electrical subsystems to high voltage supply to save weight
- Convert all lighting to LEDs

Electrical (vehicle and overhead)

Reduction of energy consumption

Improve energy management

- Better software for control of energy management flows
- More integrated heating and cooling concepts

Recuperation

- On vehicle
- Wayside (substations)

Electrical (vehicle and overhead)

Storage and re-use of braking energy

- ultra-capacitors
- batteries
- flywheels
- next generation of static storage units

Electrical (vehicle and overhead)

Hybrid trolleybuses

Combination of autonomous run and overhead current collection *to improve system facilities while of dewirement and rewirement within a goal*

to preserve *the energy captation by* ***overhead wires on straight line sections and at line section's ends*** *and*

to remove overhead wires *in downtown, when* ***passing road crossings and switches***.

Electrical (vehicle and overhead)

Improving energy supply system and overhead visual impact

- Elegant overhead lines implementation
- Inductive charging of batteries or ultra-capacitors at bus stops or en route through ground interface
- Contact charging of batteries and ultra-capacitors at bus stops
- Contactless transfer of electricity to on-board

Electrical (vehicle and overhead)

Improving energy supply system and overhead visual impact

Attention! Taking the energy from an overhead wire to date is the most efficient way to use electric energy on a vehicle. Every other form of storage and contactless transfer will lose in efficiency.

Electrical (vehicle and overhead)

Batteries expectations

Batteries of high storage capacity, fast charge and discharge, long life, low price **are gaining in efficiency** however

they **remain far less efficient than fossil fuel**. Batteries to date have **25-50 times less energy storage capacity than diesel fuel in a tank**, and even the most optimistic battery developments suggest that we may have batteries that may double their energy densities by 2025

Mechanical

Reduction of vehicle weight taking into account:

- Improvement of passenger comfort and capacity, HVAC (Heating Ventilation and Air Conditioning)
- Improvement of “Zero local pollution including visual impact” on short distance with electrical APU (Auxiliary Power Unit) (Batteries, Ultra capacitors, etc.)

Mechanical

How to reduce the weight of the vehicle:

Optimisation of the trolleybus architecture in a whole

Optimisation of high voltage devices and more efficiency of cooling systems

Drive systems optimized for the real needs of revenue service (SORT), particularly in APU mode

Designing of APU with the same trolleybus performances as under overhead line with a highly tuned required range of autonomous run for given revenue service needs

Trolleybus an integral part of city's public transport system.

To keep trolleybus in the streets of cities that historically have it as well as

to extend or modernise public transport systems through introduction of green, ecological and efficient modes is a

Grand Challenge for city authorities and operators **to convert a new proclaimed transportation paradigm into an executive mandatory maxima**.

Trolleybus an integral part of city's public transport system.

- **integration of trolleybus into the city's overall urban mobility system** in a way similar to successful integration of tramway or light rail systems, with a special attention
- **trolleybus's infrastructure is perceived** as a continuous advertisement for the system and helps instil **confidence that the transport is here today and keep confidence it will be tomorrow**.

Trolleybus an integral part of city's public transport system.

- **highlighting increased carrying capacity of trolleybus** lines with new 24-m double articulated vehicles already called as Light Trams
- showing to authorities and the general public that **trolleybus is ideally suited to BRT** (Bus Rapid Transit) **and BHLS** (Buses with a High Level of Service) priority schemes
- recognition of the fact that the **future of public transport belongs to electric modes**

Trolleybus, an integral part of city's public transport system.

Trolleybus is not opposed to other modes of urban public transport.

The reality is that **Trolleybus is the most energy efficient, financially sound and the clearest offer for green urban public transport** of the present and in the visible future.

Appreciations

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Thank you for your kind attention.

Welcome to discussion!