BusChaRM provides unique route to vehicle technology and infrastructure solutions

The journey to net zero brings challenges for all sectors. Transport has already come a long way with the emergence of electric and hybrid cars, but larger vehicles face a slower journey. Bus operators, technology suppliers and transport planners often have to base investment decisions on incomplete information or partial assumptions regarding the needs of their network.

**RICARDO
BusChaRM**

Knowledge gaps and lack of careful planning can lead to inefficiencies in network operation, use of infrastructure and energy distribution – resulting in the need for costly and extensive remedial work.

Buses have fixed routes and operate from specific locations. There is little uncertainty in scheduling, subject to traffic delays and unforeseen events. Stops at the end of the route provide a natural break to utilise opportunity charging for zero-emission technologies, such as electric charging via pantograph and hydrogen refuelling stations. However, network planning becomes significantly more complicated for large operators with hundreds of routes to manage and convert to low-carbon fuels.

BusChaRM is a unique, flagship, charger route model that allows users to simultaneously assess vehicle and infrastructure requirements across all technologies, reliably evaluating cost-effective deployment of opportunity charging within a network.

It provides an intelligent decision support tool to assess the infrastructure needs for any zero-emission bus technology, through analysis of relevant bus route and operational data. The results, which can be repeated and reconfigured for different scenarios, can help bus companies to identify the best technology for their operations, suited to existing infrastructure and vehicle type(s).

In parallel, the model also allows decision makers to test the expected CO_2 reductions for every investment option, balancing environmental and financial considerations.

Regardless of the technology specified, BusChaRM can identify the lowest cost option for optimal operation. For instance, it can indicate the ideal combination of battery size (relevant to bus type) and chargepoint locations that will result in the lowest total operational cost for the network.

The capacity of BusChaRM to determine the optimal cost-effective solution according to route topography and vehicle type makes it unique within the transport sector.

Services

In summary, BusChaRM:

- Allows consideration of vehicle type and infrastructure options at the same time.
- Is technology agnostic – making it compatible with all zero-emission technologies.
- Allows for repeatable configurations of different options, to enable testing of different scenarios and comparison of different technologies.
- Allows quantification of costs and benefits, providing cost and CO_2 reductions for every option.
- Identifies optimal technology choice for each route; sizing on-board energy storage and charger power requirements.
- Outputs provide an evidence base that can be used to engage with other stakeholders and partners on technology investment, and applying for funding.

Future applications

BusChaRM works efficiently for vehicles that have fixed routes across potentially large areas, and could be used in the future for refuse urban delivery vehicles, trucks and community transport services, or even adapted for rail applications.

It could also be used by distribution network operators to identify areas which could become grid constrained in the rollout of electric bus opportunity-charging infrastructure.

Experience

Having supported commercial operators and transport planners over several decades, Ricardo has a comprehensive understanding of the bus market and vehicle technology, advising clients globally on sustainable solutions and policy development. This background has enabled Ricardo's transport experts to develop a robust tool using GIS and Python software, drawing on the team's combined in-house knowledge and expertise in data science capability and engineering.

Project example

In 2020, Transport for West Midlands (TfWM) needed to identify optimum locations for opportunity-charging infrastructure in the region; to assess the cost-effective deployment of the network; and to determine TfWM's role in the opportunity-charging rollout.

Using BusChaRM, Ricardo analysed 2,300 buses, around 30 operators and the 900 routes that were in operation.

The results from BusChaRM identified which routes would need pantograph opportunity charging to support a 100% electric bus fleet in the region. The data also showed the most suitable locations for charging, the number of chargers required at each point and what level of power would be required.

The model was subsequently used to support TfWM further for their Bus Service Improvement Plan (BSIP) in 2022, analysing a subset of the routes within the network which covered the subsidised routes. As a result of using BusChaRM, TfWM is able to better plan for the most cost-effective electric bus charging infrastructure for the network across the region.

For more information about the services Ricardo offers on local authority net-zero planning, contact us at **enquiry-ee@ricardo.com** or **+44 (0) 1235 753000**

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