



Extension of the trolleybus system to Freilassing

Trolleybuses in Salzburg

In approximately 60 cities of the European Union, trolleybuses form an integral part of public transport. In Salzburg, the trolleybus network (that consists of 10 lines) and 3 tram lines provide the backbone of public transport. Salzburg's transportation service is complemented by several gas and diesel bus lines. Currently, the trolleybus network of the Salzburg AG has a length of approx. 100 kilometres (61.24 miles).

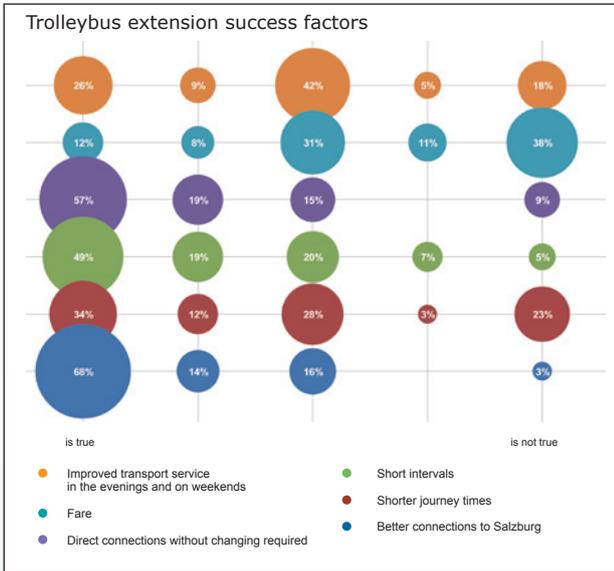
Network extension into surrounding area

The Salzburg AG/Salzburg Local Railways is a lead partner of the EU project „Trolley“. This project is concerned with questions of energy consumption optimization, efficiency enhancement in public transport and improvement of the trolley bus image.

To meet the focus on „efficiency enhancement“, the Salzburg AG authorized the investigation of a trolleybus network extension into the surrounding area. Since trolleybus line 4 was successfully extended to Hallwang Mayrwies in 2007, there has been an increasing demand for further extensions of the network into the surrounding area.

Starting point of the investigation was a general comparison between the diesel bus and trolleybus systems. Based on these findings, concrete use cases were applied to shed light on the effects of network extensions, including extension of the trolleybus network to Freilassing. Then the impact on the environment, passenger volumes and economic viability could be investigated. The results of a passenger survey on the trolleybus service in Hallwang Mayrwies could be used to gain information on acceptance of the trolleybus service.

Promoting *electric* public transport



Trolleybus passenger survey

The extension of trolleybus line 4 to Hallwang Mayrwies has led to a considerable increase in passenger volume in the last few years. A passenger survey on the new line section of trolleybus line 4 was conducted to interview passengers about the success factors. Passengers especially found the better connection to Salzburg, the direct connections and the short intervals very positive.

In general, they considered the trolleybus more environmentally friendly than the diesel bus. It also runs more often, is more modern and quiet. In addition, passengers believe that trolleybuses contribute to a more positive image of the city of Salzburg.

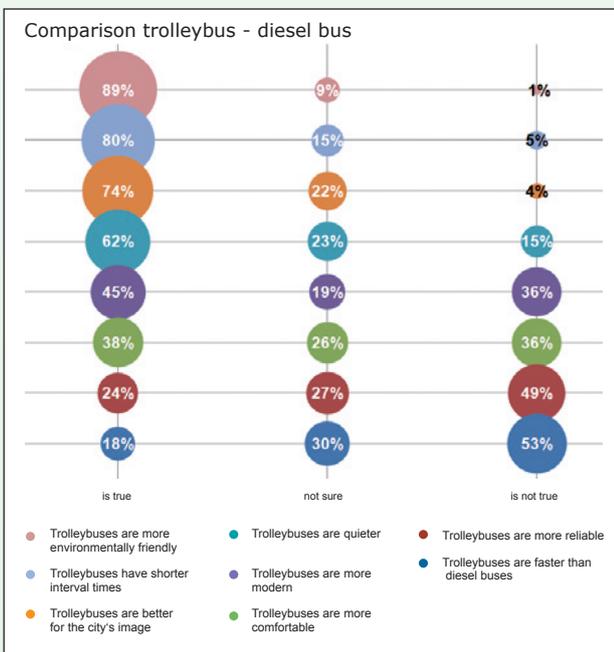
The passengers were further asked about their opinion on further improvement measures for public transport. The majority are in favour of an extension of the trolleybus network in Salzburg, but in general consider the PuT services sufficient to meet their needs. The passengers surveyed clearly disapprove of a conversion of the trolleybus lines into diesel bus lines.

Comparison between diesel bus and trolleybus

First the operating costs of diesel buses and trolley buses were compared.

A comparison between the two shows that the running costs (energy, vehicle maintenance and depreciation) for trolleybus operation are lower for average mileages than for comparable diesel bus operation. This is mainly due to the considerably lower energy costs. The maintenance costs for diesel buses and trolleybus, however, are similar. Only the vehicle depreciation costs are slightly higher for trolleybuses. The higher purchase price of trolleybuses can, however, be mostly offset by their longer average life time. On the other hand, trolleybus operation does require investments in power supply.

For a system comparison between diesel bus and trolleybus, the impact on the environment is also relevant. Trolleybus operation has the advantage that it is locally emission-free. As the Salzburg AG operates their trolleybuses with water-generated power, no emissions are produced for power generation either.





Stop catchment areas (500m) at trolleybus line extension to Freilassing

Extension to Freilassing

As an example for network extension, the trolleybus network extension to Freilassing was investigated. For Freilassing, the Salzburg AG developed two alternative service concepts:

- ▶ Alternative 1: new trolleybus express line X4 on route Makartplatz – Mirabellplatz – Kiesel – Liefering – Freilassing
- ▶ Alternative 2: Extension of trolleybus line 4 Mayrwies – Mirabellplatz – Hanuschplatz – Liefering to Freilassing

On the newly electrified route section between Liefering and Freilassing, they scheduled a 20-minute interval for trolleybuses (for both alternatives).

With the extension of the trolleybus line to Freilassing, bus line 24 can be cancelled. Bus line 24 operates the route Freilassing – Salzburg with diesel buses and runs every 30 minutes.

Evaluation from passengers' point of view

The new trolleybus express line X4 (alternative 1) allows for a 20-minute connection between Freilassing and Salzburg. Compared to the previous 30-minute diesel bus connection, this represents a considerable improvement. Moreover, the new line X4 has a different line routing in Salzburg. This means that new direct connections are offered. For instance, there are new direct connections between Freilassing and Mirabellplatz or within Salzburg, between the Münchner federal road and the Kiesel area. All in all, another 380,000 passengers per year are expected with the realization of line X4.

With an extension of the existing trolleybus line 4 to Freilassing (alternative 2), the service between Freilassing and Salzburg will also be operated every 20 minutes. As a result of line extension, there will be new direct connections between Freilassing and the Salzburg area that lies to the east of the Salzach river.

Economic viability

The trolleybus connection to Freilassing requires investments in the infrastructure of approx. € 2.7 m. In addition, new vehicles must be purchased. For the trolleybus express line that runs every 20 minutes (alternative 1), 3 trolleybuses are required. For extension of the existing trolleybus line 4, with the same interval time (alternative 2), only one additional vehicle is required. In both cases, bus line 24 can be cancelled and up to 3 diesel buses taken off of the road.

The running costs for operation also change. They are based on personnel requirements, energy consumption, vehicle maintenance and maintenance of the power generation facilities.

Compared to the previous operation with diesel buses, the running costs for an express line with trolleybuses (alternative 1) are approx. € 420,000 higher per annum, due to the extended service provided. The higher costs are partly offset by an estimated additional revenue of € 280,000 per year.

During normal operation, however, an extension of existing trolleybus line 4 to Freilassing (alternative 2) is approx. € 50,000 less expensive per year than the previous operation. This is possible, in spite of the shorter service intervals to Freilassing. This is because within Salzburg the parallel service of line 24 (diesel bus) and trolleybus line 4 can be cancelled.

Environmental impact

The trolleybuses of the Salzburg AG run on water-generated power. This means that no pollutant emissions or direct greenhouse gases are produced during power generation. The operation of diesel buses, however, does locally release large quantities of pollutant emissions.

With cancellation of bus line 24, the CO₂ emissions can be reduced by 200 tons per year. In fact, the emission of other pollutants such as particulate matter and NO_x are also reduced. If you calculate the cost of environmental damage, this solution saves the national economy approx. € 40,000 per year. It further improves the environmental balance, if previous car drivers can be won as new customers of the public transport system.

Conclusion

Surveys conducted on the acceptance of trolleybuses show that passengers and citizens evaluate trolleybuses as mostly positive. Trolleybuses are considered environmentally friendly. The environmental aspect is also considered important for the trolleybus network extension to Freilassing. Here the diesel buses along the densely populated axis between Freilassing and Salzburg are replaced by trolleybuses.

An analysis of the economic viability of the two service alternatives shows the following result:

- ▶ With the extension of the Salzburg trolleybus line 4 to Freilassing, a higher level of service can be provided at less operating costs than for the diesel bus line.
- ▶ The new trolleybus express line X4 also increases the service level to Freilassing. Here the result is higher costs. These can, however, be partly offset by the increased revenue potential.

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