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Drivers and barriers to the electrification of public transport in the Maltese islands

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This article gives an overview of the current public transport system in Malta and Gozo, outlining the main drivers and barriers present in the local context to shift the current bus fleet to electric.

Introduction

The process of changing the whole bus fleet from diesel to electric involves a lot of planning. The transition from diesel to electric can be driven by national legalisation or by a policy that drives the transport operator to shift to cleaner vehicles. On the other hand, since electrification is something new for the Maltese islands, there are a lot of things that are still unclear. The shift to electric buses involves a lot of changes in the current operating system as well as in the maintenance system, which raises questions about how the transition will affect the operations and maintenance?

Furthermore, there are also barriers related to the charging infrastructure which require a long-term plan. This raises questions about the ideal location of the charging infrastructure and the need for upgrades to the current power supply system.

The transition to electric buses involves constant communication with local institutions mainly with Transport Malta, the national transport authority, and Enemalta (the electricity provider). Given the new technology of battery-electric buses, there are uncertainties about their maintenance and their lifetime arise questions such as what happens when the battery lifetime is exceeded? Does this mean that the buses must be replaced? What will be done with the old batteries?

The current bus fleet in Malta [1]

Current public transport fleet

The total bus fleet in the Maltese islands consists of 420 diesel buses, split between the two islands of Malta and Gozo. The public transport system in Gozo consists of a fleet of 23 diesel buses. Twenty-one of them are nine-metre buses while two are twelve-metre buses. The fleet in Malta has 396 diesel buses: 2 minibuses, 124 nine-metre buses and 270 twelve-metre buses. All the buses have the latest Euro 5 and Euro 6 technology, being one of the most modern bus fleets in Europe [1].

Although the current bus fleet complies with lower emissions when compared to older diesel buses, there are still considerable CO2 emissions. If diesel buses are replaced by fully electric buses, the public transport fleet will be transformed into a zero-emission fleet, promoting cleaner and more sustainable mobility. In Malta, the operator launched its first electric bus pilot in 2020 [2], and in April 2022, two new electric buses were added to the current fleet with the plan to fully test them on current public transport routes [3]. The performance of these buses will be used to assess the operational requirements in the local conditions and the results can be useful for future procurement of a larger fleet of electric buses.

On a national level, there are some drivers to encourage the shift to electric buses but there are also a lot of barriers that need to be overcome to enable the shift to electric public transport.

TAM Electric bus pilot project in 2020 on the left side [2] 2 new electric buses launched in April 2022 on the right side [3]

Drivers to electrification

Transport operators are driven to shift to cleaner buses with lower/zero CO2 emissions to provide cleaner public transport. That can attract more customers and encourage them to shift away from using their private vehicles. In some test cases of electric buses like the Bremen and Oberhausen, passengers and drivers both had positive feedback on their experience using electric buses [4]. The passengers were satisfied with the riding comfort and were keen on using an environmentally friendly transport system. If more passengers are attracted to the electric public transport system, there will be a better use of the roads resulting in reduced congestion and thus indirectly leading to increased public transport efficiency. This could make the public transport system more reliable, possibly attracting new commuters to use public transport instead of their private cars.

Since battery electric buses produce zero emissions, there would be improved air quality, hence improving the citizens' health and quality of life. Battery-electric vehicles produce less noise when compared to conventional diesel vehicles hence reducing noise pollution. In Freiburg, residents had positive feedback on the electric bus operation, which produces less noise levels when compared to diesel buses [5]. Electrification could contribute to a better marketing strategy for the public transport company, by promoting the benefits of the improved bus technology and the lower impact on the environment. Moreover, electric buses offer improved passenger comfort since they produce less vibrations leading to a smoother drive. This enhances the image of the transport operator and shows that the operator cares for its customers [6].

National policies and strategies are driving transport authorities to encourage the shift towards electrification. This includes the National Transport Strategy 2050 which states that the target is to shift away from conventionally fuelled cars by 50% by 2030

and a complete phase-out by 2050. Current and future Maltese legislations define targets to reduce emissions while many European Union (EU) directives are setting emission standards that must be met within defined target dates.

To further drive the shift to a fully electric public transport system, there are several national and EU incentives that can be used to fund the acquisition cost of the electric vehicles and the involved charging infrastructure. Using these incentives, the transport operator is urged to change the current diesel fleet to a zero-emission bus fleet whilst taking the opportunity to increase ridership and revenue through electrification.

Barriers of electrification

One of the first barriers to changing the current fleet to electric in Malta and Gozo is the charging infrastructure [7]. It is related to identifying the ideal charging location. Due to the limited space on the Maltese islands, it may be difficult to find an area where all the electric buses will be charged during the night (depot charging). Lack of access to land is a potential barrier to installing the charging infrastructure. If the property is not owned by the operator, there have to be discussions with the landowner to allow installation and maintenance of the charging infrastructure, especially when there is a scale-up of the electric bus fleet. Due to the fire risks related to battery electric buses, a risk assessment must be done before choosing the location of the chargers. Ideally, the electric buses are not located next to the fuel station of diesel buses as in case of fire, there is a higher chance of the fire spreading from one bus to another. Through the eBussed project, some regions highlighted the importance of fire safety when it comes to the depot of electric buses. In Utrecht, buses are separated by concrete firewalls or split into small batches so that in case of a fire, it doesn't spread and damages a larger number of buses. Given the limited depot

Two new electric buses launched in April 2022 [3]

size, the space available must be maximised, so when planning the depot design the limited space may be overcome if the chargers' supply comes from the roof. This idea was learned from the eBussed project, where in the Hochbahn Depot in Hamburg the electric buses are divided into sections and the charging cables are taken from the above as shown in the picture below.

Hamburg Hochbahn Depot- Picture was taken during the Hamburg final seminar in May 2022

If fast chargers are needed to supplement charging throughout the daily operation, changes must be made to the existing road infrastructure. Upgrading the road infrastructure involves more costs as well as constant communication with the transport authority that must approve the proposed fast-charger locations. For the installation of fast chargers, there must be adequate space for the electric buses to have a stopping time of 20 to 30 minutes, without affecting the operation of the other road transport vehicles.

Another barrier is the provision of the required power supply for the charging infrastructure. Since the buses will be charged more or less at the same time during the night there needs to be an upgrade of the current supply system. This upgrade involves a lot of planning and discussions with the electricity provider, Enemalta, which is the power distributor of Malta and Gozo. There could be huge costs involved depending on the supply requested and on the level of upgrading required. Since it is still unclear who will be responsible for these costs, this could discourage the operator to invest in a fully electric bus fleet. Because of this, discussions with the relevant authorities have commenced to start preparing for the shift to electric buses, these discussions are aimed at identifying the ideal charging locations as well as the supply requirements to supply the chargers in the different locations around the Maltese islands.

Another potential barrier is related to the distribution of the power required. It is still unclear how the distribution from the meter to the charger is catered for, who will be responsible and what steps should be considered for the connection between the meters' supply and the chargers. There also needs to be a conformity of the software used for communication between the supply and chargers, where the software must coordinate the charging time to ensure that the power load does not exceed the supply limit. The operator is currently researching the market, to analyze the most adequate package for the chargers and the depot management software. The aim is to have software compatible with different brands of electric buses so that it can be used in the future when there is a large fleet of different brands of electric buses.

To ensure that the transition to electric public transport is smooth and sustainable, the technical specifications of the proposed buses must be analyzed in the local context before the procurement phase. Given that the topography of the Maltese islands is characterized by steep road elevations and frequent stops due to the short distance between bus stops, the electric buses must have the necessary technical specifications to operate in these conditions. In a steep uphill, the energy consumption is higher when compared to operation on a flat surface decreasing the range (kilometres) that can be operated on electric buses. Considering that the local weather condition is characterized by a very hot summer, the air-conditioning system must have the necessary power to retain a comfortable temperature inside the bus. However, the use of the air conditioning system will increase the consumption, again limiting the operating range. Since the range of electric buses is limited when compared to diesel buses [7], there will be a drastic change in the current operation. With the introduction of e-buses, there must be allocated time for charging, when the bus will not be in service. This will result in more costs as explained hereunder. To avoid the creation of extra stop time for the buses to charge, the operator is considering that the fast charging occurs at the driver's break locations.

It may be that operating the current route network with e-buses will require more buses as the ratio of diesel buses to e-buses is not a clear 1:1: it is rare for an electric bus to operate for a full day with one charge. This will therefore lead to a decrease in the efficiency of resources and increased operating costs. The operator is trying to plan for this transition by testing different electric buses in the local scenario to try and estimate the maximum kilometres that can be travelled by electric buses. Then, based on this range restriction, the number of buses needed to be able to operate the same service can be approximated.

Since the operators' technical staff have little experience with e-buses, there must be a thorough training programme. The lack of experience discourages the public transport operator to shift to electric buses since it is something new and it requires time and experience for the technical team to gain the necessary knowledge. As a result, the process may take longer than with diesel buses, and this may increase the period where the electric buses are out of service having a direct impact on the operation. Therefore, to continue operating the service, these buses may still need to be replaced by diesel buses. To overcome this barrier, during the procurement of new electric buses, the operator is requesting a training programme as well as the daily assistance of the bus suppliers' technicians, who are requested to be on-site during the first years of operation so that the local technical staff has the support necessary to fix electric buses.

Another barrier to the electrification of the local public transport is related to the availability of right-hand-driven buses. Currently, there is a larger market for left-hand-driven electric buses causing a limited choice of the available bus models in Malta and Gozo.

When compared to a conventional diesel bus, the initial cost of an electric bus is higher, and more electric buses are required to replace the current diesel buses. Therefore, the electrification of public transport requires a lot of funding [8]. Large-scale implementation of electric buses requires a large investment, not only to procure the buses but also to supply the necessary charging infrastructure and electric grid upgrades. If the institutions do not provide the necessary funding, the transport operator would not be capable of financing all the necessary costs to shift towards electrification. This challenge is being tackled through constant communication with the local authorities.

Another obstacle to electrification is the degradation of batteries and what happens after their lifetime is exceeded. A battery lifetime is usually from 8 to 10 years. After this period, new batteries must be acquired resulting in increased costs to the operator [8]. Given that the lifetime of a bus is usually around 10 years, it might not be viable to replace the old batteries, but it might be more commercially viable to replace the whole bus instead. Due to this, the operator would be constrained to change the buses/batteries after 10 years, resulting in more costs. Therefore, for future procurement, the operator is requesting a battery warranty period of at least 8 years. During the period, the manufacturer is responsible for the batteries and must ensure that the capacity of the batteries is still sufficient for operation.

With regards to batteries, it is still not clear where the old batteries will be disposed of, considering that there may be chemical release from the dead batteries, which could result in a negative environmental impact in the long run. As learned at the eBussed site visit in Hamburg, the VHH depot's old batteries are stored in a container and are used to supply the chargers during peak demand. In the Maltese islands, this idea could be valid in the future.

Conclusions

Initially, this article provides information on the current public transport in the Maltese islands. If the whole bus fleet is changed to electric, there would be a huge reduction in the CO2 emissions resulting in a cleaner public transport system. Thus, the operator is gradually adding electric buses to its current fleet, to start the transition toward a zero-emission bus fleet.

The next section summarizes the drivers and barriers related to the electrification of the bus fleet in the Maltese islands. Most of the drivers are related to the benefits of cleaner public transport, resulting in an improved quality of life and lower noise and CO2 emissions, which could eventually lead to an increase in the use of public transport. The other drivers are related to the national and EU strategies and policies in place that are encouraging and funding the shift to cleaner public transport.

Hamburg VHH storage of old batteries- Picture taken during the Hamburg final seminar in May 2022.

Since electrification is still relatively new, especially in the local public transport sector, there are many barriers related to its unknowns; mostly related to the planning, funding, operation, fixing, and maintenance of electric buses. Moreover, there are also other barriers related to the charging infrastructure. The first barrier is to find the ideal location for the chargers and plan for the grid updates that must be done to supply the chargers. Other barriers are related to the increased operating costs considering that more electric buses would be needed to operate the current service, especially considering the characteristics of the local context: hilly topography and high operating temperatures in summer requiring the use of air conditioner, both resulting in lower daily range. The lack of experience of the technical team when it comes to fixing electric buses is also a disadvantage. To deploy electric buses, the operator requires funding both for the buses and for the charging infrastructure, as well as the related costs to upgrade the supply. If there is no support funding to aid in the expenses involved, it would be very expensive for the operator to electrify the bus fleet. Finally, the lifetime of the bus and its batteries is also a concern for the operator. Given that the usual lifetime of the batteries varies from 8 to 10 years and the lifetime of an electric bus is 10 years, this could mean that the electric buses need to be replaced after 10 years, resulting in more costs in the long run.

Through the eBussed project, some practices implemented in other partner regions are relevant to overcoming the barriers to electrification the public transport in Malta and Gozo. Considering that the Maltese islands are at their initial phase of implementing electric buses, the project has provided knowledge and practical solutions when it comes to the procurement, planning, charging and testing of electric buses.

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