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‘’ Electric heavy duty trucks in Europe more and more upcoming ‘’

Harm Weken[1], Edwin Bestebreurtje[2], Rob Kroon[3]

[1] *Managing Partner at FIER Automotive, harmweken@fier.net*

[2] *Senior Consultant at FIER Automotive, ebestebreurtje@fier.net*

[3] *Project Manager at FIER Automotive, rkroon@fier.net*

Executive Summary

Many large European cities and transport hotspots are dealing with air quality issues. One of the main contributors to this issue is heavy duty trucks distribution in the inner city and short distance (last mile) distribution. In several European projects, possibilities with electric heavy duty solutions are implemented, tested and exposed. The aim of this paper is to present a brief overview of two EU funded projects on electric heavy duty transport; FREVUE and eGLM. FREVUE focuses on inner city distribution with 9 – 18 tonne full electric trucks being used in 8 different European cities which are analysed from a financial and operational perspective. Also a feasibility study on the development, production and implementation of 40 to 50 tonne full electric trucks for Last Mile transport solutions will be discussed within this paper.

Keywords: Battery electric vehicle, demonstration, fast charge, freight transport, heavy-duty

1 Background

One of the goals of the 2011 European White Paper for Transport is to achieve “essentially CO2 free city logistics in major urban centres by 2030”.The Paper recognises that achieving this through the use of electric vehicles (EVs) is likely to eliminate other harmful pollutants in city centres at the same time. Furthermore, within the 2013 Urban Mobility Package, a call for action in urban logistics identifies FREVUE as a European Commission flagship project. The FREVUE project supports the introduction of electric freight vehicles by demonstrating and evaluating innovative urban logistics solutions in eight of Europe’s largest cities. Next to FREVUE, a new cross-border project has been launched in 2017, called “eGLM” (electric Green Last Mile) which also links with the European White Paper for Transport.

Last mile (city) logistics cases not only have a great potential for hazardous emissions reduction, but they can also contribute to the uptake of electric vehicles and the introduction of new concepts and business models. Despite this potential and the strong policy support, electric vehicle use in the logistics sector has been constrained by a number of barriers. These barriers include high investment costs, limitations with respect to range, payload and volume, and constraints with the current charging infrastructure.

2 FREVUE

2.1 Introduction

The EU funded project FREVUE has supported the implementation of over 70 Electric Freight Vehicles (EFVs) in 8 different European urban regions to prove that already available electric vans and trucks can offer a viable alternative to diesel vehicles. Particularly when combined with state of the art urban logistics applications, innovative logistics management software, and with well-designed (local) policy (FREVUE).

These 8 European urban regions are main city regions within Western Europe with a lot of city distribution vehicles and many emission and congestion issues. Figure 1 shows an overview of these 8 cities.

Figure 1: overview FREVUE cities

The partnership of FREVUE consists of the main cities, grid operators, logistic partners, vehicle manufacturers, ICT partners and research and support partners. They all worked together in the main cities to be able to set up the pilots and cases. Within the consortium, knowledge has been shared through all kinds of workshops and events. The consortium also organises events in order to disseminate the knowledge to other regions and set up other initiatives.

2.2 TCO calculations

Rotterdam is one of the urban regions in which FREVUE has the goal to set up pilots with electric trucks for inner city logistics. FIER, partner of FREVUE, supported the process of setting up pilots in Rotterdam by conducting one-on-one case studies together with transport companies and (EV)-truck manufacturers. These one-on-one case studies were the baseline for TCO-calculation comparisons between electric and diesel trucks, which were used in the decision-making processes of the companies.

Figure 2: Battery Electric Trucks Breytner / EMOSS

By building the tailored case studies, many important topics in decision making processes have been defined as current boundary conditions with regards to the purchase of electric trucks. These topics were investments in the vehicles and charging infrastructure, daily routing, warranties (battery and driveline), reliability during the whole lifespan, downtime, service costs and residual value. The conclusion based on these topics and boundary conditions is that without any external financial support, the investment and TCO gap between diesel trucks and electric trucks was too significant. Even with some additional funding from the EU, it was a tough call for the transport companies to decide. This because they have to compare a new 'limited tested' technology with a proven technology with a history of more than 100 years. In this history and knowledge, it was not only the technology itself that is important, but also the service levels and certainties around maintenance and repair costs. With the ICE vehicles, a service network exists in every corner of Europe with a price level and competition that matches the expectations of the transport companies. With the current EV alternatives and offers from retrofitted companies there is not such a network with a service level and price level that matches these expectations. Even when the maintenance costs are equal or a little bit lower than the ICE vehicles, the risk of down time and the costs of down time, because there is no dense service network, is a negative aspect of the TCO for an EV truck.

2.3 Conclusions and key figures

The TCO and utilization profiles within the FREVUE case studies show that tailor made configurations of battery package, range, charging infrastructure, route planning and battery planning are very important to be able to be successful in zero emission inner city distribution. The successful cases all have a combination of dedicated charging infrastructure, a dedicated consolidation centre and fit for use retrofitted electric vehicles with a range with small overcapacity in the daily routes. Most of them have the possibility to recharge (partly) during the route. The positive points like zero emissions and reduced noise that EV trucks have, can have a positive effect on the TCO when it is possible to operate during night time within the city and also in special zones such as environmental zones and bus lanes. Cities and regions can stimulate and support by changing their policies for inner city distribution and give advantages to clean and silent vehicles compared to other vehicles. When regions and cities create a higher demand for distribution companies to include zero emission inner city vehicles in their fleets, not only retrofitted solutions, but also OEM-solutions will become more and more common. Competition will lead to better prices, higher series

and better business models. Not only the purchase price will be more competitive compared to ICE solutions, but also better maintenance and repair networks will exist. On the long term, the TCO for the electric trucks will become more positive.

Some Key figures of Battery electric trucks within FREVUE in Rotterdam:

- Breytner Transport Rotterdam: EMOSS, weight 19 tons, electric drive range 200 km, battery pack 200 kWh, daily routes 100 – 150 km inner city.
- Technische Unie: EMOSS, weight 19 tons, electric drive range 200 km, battery pack 200 kWh, daily routes 130 km combination highway and inner city.

Figure 3: Key figures Battery Electric Trucks FREVUE Rotterdam

3 electric Green Last Mile - eGLM

An international consortium of logistics organisations, a regional development & investment company and a business development company started the eGLM project in 2017 to implement a zero-emission fleet of electric trucks. The three-and-a-half-year project electric Green Last Mile (eGLM) has financial support of the European Union (INTERREG Germany – Netherlands), the Province of Limburg and Ministry of Science, Energy, Industry and Economics of Nordrhein-Westfalen with a total budget of EUR 5,2 million.

3.1 Ambition

The overall goal of the eGLM-project is kick starting the market of heavy duty electric trucks, showing the transport sector that dedicated electric trucks can be applied for specific applications in a commercial viable way. Via this project we will start with the first steps towards a critical mass. Also, we are going to contribute to the standardisation of fast-charging by implementing a small network of ultra-fast charging within the region.

Figure 3: Application area of the eGLM project

We are going to achieve this goal by the implementation of 8 to 10 full electric heavy-duty trucks including 5 ultra-fast charging stations within the containers and distribution transport sector of the cross-border logistic hotspot region of North Limburg - Duisburg. A solution that meets the demand of the transport

sector and the priorities of Euregio, will contribute to creating a market leadership in electric-powered heavy-duty trucks as well as innovative smart sustainable logistics concepts. The consortium of logistic companies, Meulenberg, Köppen, Samskip, CTV and KLG, supported by LIOF and FIER Automotive, have the goal to create a feasible solution by bundling the power and knowledge.

Prior to the start of the eGLM project in Q1 2017, a study has been executed to determine the feasibility of the project. Within this study, four main subjects have been investigated. These subjects were technical, economical, logistic and financial feasibility. From this study, the consortium has learned that the eGLM project is challenging but achievable.

As with the FREVUE project, one of the biggest challenges is the financial feasibility. Due to the fact that the eGLM products aren't available at this stage, the initial purchase costs are expected to be very high compared to a conventional diesel truck. This leads to fact that the business case for the logistic companies will not be feasible with the current state of the market. That is one of the reasons why we have successfully applied for funding at INTERREG to close the gap in the TCO calculation and stimulate the market development.

3.2 TCO

It is well known that the purchase costs of the electric trucks are higher than the diesel equivalents, and that the operational costs are often lower. Therefore, it means there should be a break-even-point at a certain mileage where TCO costs are comparable. Although there is some funding available, the BEP is not easy to reach, because there is a limited range on the battery electric trucks. Currently, almost all electric trucks are using night charging only, which means they will only charge once per 24 hours. If we would apply the same principle for the eGLM trucks and we would like to come close to the mileage per day that closes the gap in TCO costs, the battery will need to be very large. This is not an ideal situation, because there is limited space on a truck to store the batteries. This means the batteries will need to be stored on locations where it will have a negative impact on cargo space, vehicle dynamics, etc. It will also mean the weight of the vehicle will significantly increase, meaning less cargo to be transported. Finally, also the costs of the batteries plays a dominant role in the cost price of an electric truck, meaning the purchase price will even be higher.

3.3 Ultra-fast charging

Therefore, we know that a right balance between battery size and charging infrastructure needs to be made. This means ultra-fast charging is necessary, so also the trucks can be recharged with electricity during the complete operating window. In the world of electric passenger vehicles there is some sort of standardisation of fast charging, but there are still some differences between continents. Next to that, there are huge developments going on, meaning that the standardisations keeps evolving. The standardisation for heavy duty vehicles is not set, but also for this application there are important developments. There are a couple of examples where ultra-fast charging is applied for busses, meaning these busses are charged with a pantograph system or via inductive/conductive charging below the bus. We are currently investigating what kind of system would work for the eGLM trucks.

Figure 4: Artist impressions eGLM trucks

3.4 Usage optimalisation

To insure the electric trucks are used in the most efficient way, an analysis of the intended usage has been made. This analysis results in suitable routes where the electric trucks will be used to their full potential. By analyses of the individual logistic cases, a list of specifications is created for each partner.

Within the eGLM consortium, none of the trucks are going to be used in the same way. For example, Meulenberg is going to drive within a radius of 20 kilometres on secondary roads, where Samskip will use the truck to drive up to 75 kilometres on the German highway.

These varieties in the usage of the trucks and the effect on the range of the trucks are of key importance for the vehicle manufacturers in the further development of electric heavy duty trucks. Therefore, the trucks are going to be monitored by knowledge institutes. With the results of the monitoring, the institutes will analyse the outcomes to come to conclusions and recommendations for the logistic companies. This way the usage can be improved, higher mileages can be achieved and the cost per kilometre can be lowered. The info will also be shared outside of the consortium so other logistic organisations and the industry can benefit from it.

3.5 Truck sharing

Besides the innovative products within the project, a brand-new concept will be introduced. This concept is the exploitation of e-truck sharing. As mentioned, the cost of using an electric truck gets more interesting when more kilometres are driven. One way to do this, is by sharing trucks between different organisations who have got different usage patterns. For example, a truck which is used during daytime, 8 hours a day, for transport on a terminal, could also be used at night time by a different company for transport between terminals on the highway. Due to this fact, the consortium is going to initiate a sharing concept, together with the help of knowledge institutes. The introduction of this program is planned for 2019.

The goal of the eGLM project stands directly in line with FREVUE. With the implementation of zero emission last mile logistic solutions, both projects will contribute to the improvement of air quality and the lowering of the noise caused by freight transport. The knowledge and experience of the FREVUE project will be implemented in the eGLM project.

Some <u>expectations</u> of the key figures of eGLM

- Truck will drive 200 to 250 km a day;
- Range of the truck will be between 150 to 200 km with a battery between 200 and 320 kWh;
- Night charging will be 22, 44 or 88 kW;
- Ultra-fast charging between 150 and 600 kW;
- GVW +/- 10 tons
- GTW between 40 and 50 tons

Figure 4: Key figures eGLM

4 Results and Future Perspective

Both European projects will have a lot of experiences and knowledge that can be shared internationally. Results from the FREVUE project already show that inner city logistics with full electric heavy duty vehicles is possible in a technical and behavioural perspective, but not yet economic feasible without some financial support from the governmental side (cities, regions eg.) and without thinking in new configurations, consolidation centres, route-planning and battery planning. Also important is that a maintenance and repair network for the electric trucks is created to lower the risk and costs of down time when a vehicle has a technical problem. Because of higher purchase costs and lower operational costs, a higher utilisation results in better business cases for electric trucks.

Future perspective of electric trucks in inner city distribution is depending on a combination of policy from cities and regions and upscaling the market. Upscaling the market can be done by initiatives such as FREVUE by setting up pilots and business cases, but the next step after the pilots is to create higher demand to stimulate the market to develop OEM-solutions, with higher series and more competitive prices. This also will lead to a better repair and maintenance network lowering the risks and costs of down time.

Expectations of eGLM are within the same context. Technical solutions exist but are not yet there for 40t+ applications. Owners/drivers are willing to change but economic feasible solutions cannot be expected yet, but will be better in a shared fleet within a consortium. New smart and strategic logistic planning is key for creating a better business case.

The legacy of eGLM will be a 2,5 year driving experience, over 2.000.000 full electric km’s driven and a CO2 reduction of about 1.900 tons, which is a modest first start. There will also be a standard set on ultra-fast charging for heavy duty applications at strategic locations, open for public usage. An innovative logistic concepts for truck sharing will be launched. Our aim is also to bring the spark for all-electric transport and creating eGLM spin-offs at other logistic hotspots such as Chemelot, Rotterdam, Antwerp, etc.

5 References

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6 Authors

Harm Weken MSc is Managing Partner of FIER Automotive since 1995, a business development company in the international automotive sector, with a focus on electric mobility. Harm is also chairman of the board of Foundation Limburg Electric and member of the Council of Advisors at Drive Oregon. From 2007 till 2015 he has been Board-Director of EASN ltd, a European platform for automotive clusters and starting-point of various EU-projects.

Edwin Bestebreurtje MSc is partner and senior consultant of FIER Automotive & Mobility**.** Edwin has been specialized in business development projects in the automotive and mobility sector. He was responsible as project manager for developing the Automotive Campus in Helmond and project manager in European projects on (e-) mobility, such as ENEVATE and I-CVUE. Edwin was also responsible for several innovation missions inside and outside Europe with important mobility topics. He has been involved in many projects and initiatives.

Rob Kroon BSc has a wide experience in the automotive and (electric) mobility sector. Employed as Project Manager / Consultant at FIER Automotive, he worked on several EU projects like ENEVATE, I-CVUE, FREVUE, BATTERIE and their spin-of projects. Due to the involvement in these EU projects and other business development projects, Rob has built experience, knowledge and an interesting network in the field of electric mobility.