Case Study

SRF ELECTRIC DELIVERY VEHICLES CASE STUDY

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Why electrify urban delivery vehicles?

In recent years the issues of climate change and urban air quality have risen up the social and political agenda. The tide of public opinion is changing, increasing pressure on the road freight sector to provide new, lower emission alternatives to replace current technologies. Electrification has been identified as one of these potential solutions due to grid electricity having a lower carbon content than fossil fuels.

Urban delivery vehicles are a key source to address as they are currently responsible for producing 11% of the emissions from road freight [1], and this is projected to rise with the world's urban populations expected to add 2.5 bil. more people over the next 30 years [2]. Furthermore, the rise of e-commerce and home delivery means the need for small/medium capacity road freight in urban areas will rise in the foreseeable future.

Electric vehicles are highly suited for start-stop city driving. They provide zero emissions at the point of use which could dramatically improve urban air quality since 30% of particulate emissions in cities come from vehicles [3]. Electric motors allow EVs to take advantage of regenerative braking; recovering kinetic energy to be stored in the battery. There is also potential for EVs to provide cost savings for users in the long term.

SRF Electric Delivery Vehicles Project

Aims

- Compare the operating emissions of electric delivery vehicles with conventional diesel delivery vehicles.
- Analyse users operation characteristics (utilising regenerative braking; and improving vehicle load factor) which affect the emissions performance of electric urban delivery vehicles.

Industrial Partnership

- A partnership was formed with Wincanton, who run FUSO eCanters as part of their normal daily operations.

Data logging

- Data was recorded from both diesel and electric Wincanton vehicles, using the SRF logger, in-order to make comparisons.

Develop models

- Electric and diesel vehicle models were developed and validated to within ±5% and ±10% respectively for their energy consumption. Figure 1 shows the level of agreement achieved in the final model.

Simulate operations

- Simulation models were used to equalise variable factors between the electric and diesel deliveries, and the models were used to investigate operating conditions

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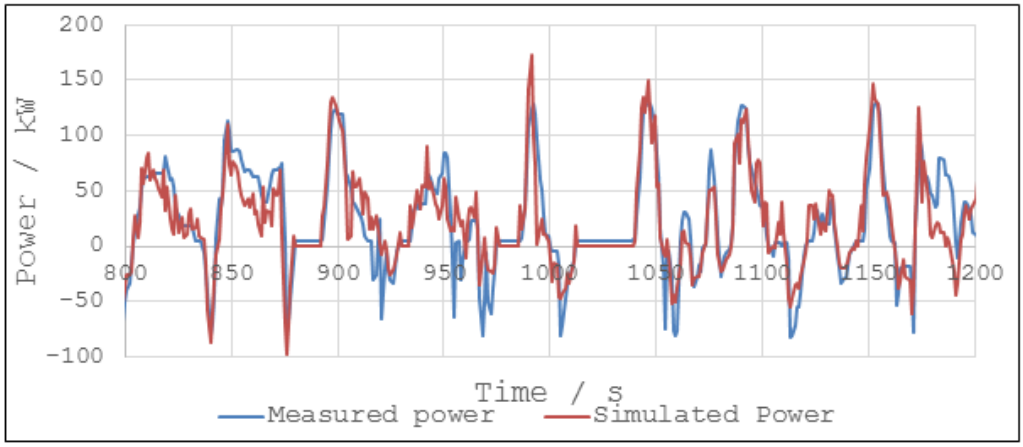


SRF Electric Delivery Vehicle: Results

The finalised models were used to simulate 3 full days of the industrial partner's drive cycles over which the performance of the two vehicle types were compared. *Results are displayed in Figure 2.*

1) A 71% decrease in emissions made by switching from diesel to electric delivery vehicles.
2) Techniques for further emissions reduction were then studied. If the electric delivery vehicle drivers were to use regenerative braking, a further emissions of 32% would be achieved, bringing the total reduction from diesel delivery vehicles to 81%.
3) This industrial partner was determined to be using their electric delivery vehicles at a load factor of 0.1 due to the unusual logistics contract. Suggestions were made for how this load factor could be increased to 0.2, which would yield a 47% reduction in emissions as shown in *Figure 3*.

Performance load Factor

The effect of packing was investigated using the performance of load factor. This was chosen as the vehicle was determined to be max load limited when transporting its current type of product.
Load factor was defined as:

$$Load\ Factor = \frac{Load\ carried}{Max\ Load}$$

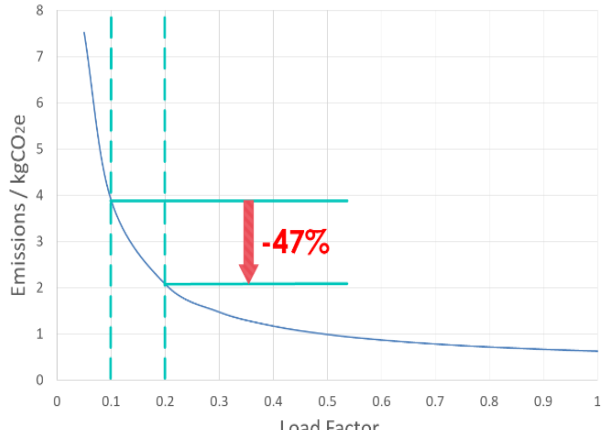
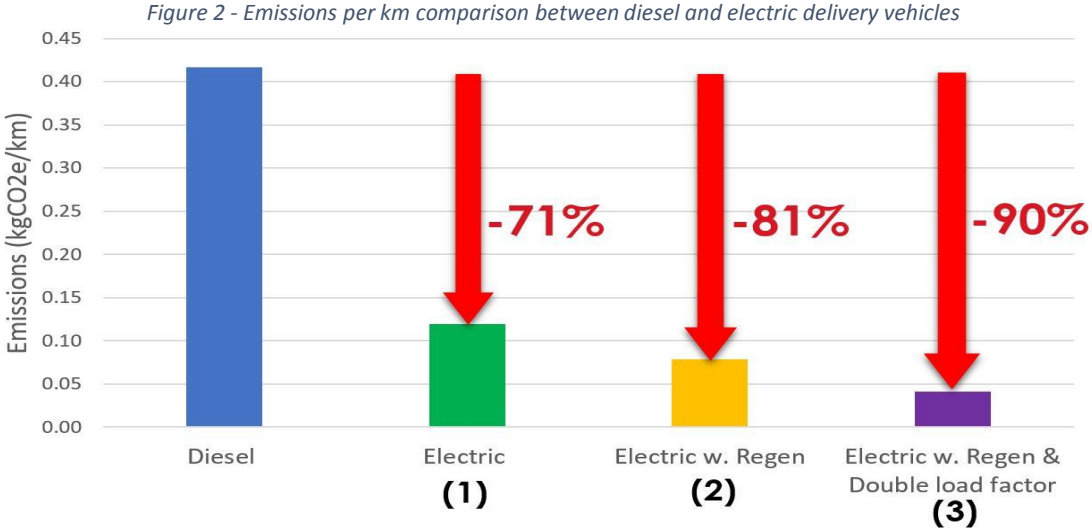


Figure 3 - Emissions against load factor for one of the full days running

Figure 2 - Emissions per km comparison between diesel and electric delivery vehicles



References

[1] UK Department for Transport, 2017 [Online] Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/590922/freight-carbon-review-2017.pdf

[2] U. Nations [Online] Available: https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

[3] World Health Organisation, "Air pollution," [Online]. Available: https://www.who.int/sustainable-development/transport/health-risks/air-pollution/en/