ENERGY SAVINGS TRUST ZERO EMISSION BUS MARKET TRANSITION SCHEME 2022/2023

Maynes Coaches

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Content

1 - Introduction

Maynes Coaches is a Coach Operator based out of their main depot in Buckie, Moray. They also run a depot in Elgin supporting contract work in that area, as well as a depot in St Margaret's Hope, Orkney.

Maynes run 20-30 vehicles a day out of these depots servicing a variety of private hire, holiday, contract and school work. They also provide luxury services under their newly launched Legacy banner.

The fleet comprises a mix of vehicles, all but 4 up to Euro 6 emissions standard.

The main fleet are fitted with GPS devices that provide detailed telematics information.

An analysis of the 2022 telematics data shows:

> Drove **1,742,202 KM** producing approx. 1,447 **tonnes of CO2** which would require planting 57,880 **trees to offset**.

This study aims to understand how operations are currently run and then to model, using the technology available today, what percentage of journeys could instead be performed with Zero Emission vehicles.

As the only ZE coach on the market is the electric Yutong TCe12 the study also investigates electrical power needs and feasibility as well as the price difference between replacing vehicles with Electric versus Diesel.

This has been achieved by performing analytical models using telematics data to understand:

1. **The percentage of journeys that can be perfomed by the Yutong TCe12 if the Buckie depot is electrified;**

2

The percentage of journeys that can be performed by the Yutong TCe12 if all depots are electrified;

3

The power required to electrify the main Buckie deport using different speed chargers and numbers of vehicles.

A desktop depot survey has been undertaken to understand current power available to the Buckie depot, as well as the cost and timescales to upgrade that connection.

A plan has then been created that provides a roadmap towards a just transition to Zero Emissions including a Return on Investment calculation and considering the potential socialisation of charging infrastructure.

2 - Simulations

In 2022 Maynes Coaches ran 7,891 vehicle journeys activities that were in the scope for investigation at an average of almost 22 vehicles being used per a day representing 1,742,202 total KM driven.

Of these if the Buckie depot were electrified 2,595 could be performed using the Yutong TCe12 charging at its maximum rate of 150kW as required (assuming charging is always available). That is **33%** of journeys representing 336,465 kms which would save **280 tonnes of CO2 per year**.

22	7,891	1,707,097
vehicles per day	vehicle journey activities	total km driven

2,595	336,465

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If charging could be made available to all depots these figures rise to **46%** (3662 journeys, covering 510,510km saving 425 tonnes of CO2 per year.

The graph below shows that the work pattern is high during the week and drops significantly every weekend and during holiday periods.

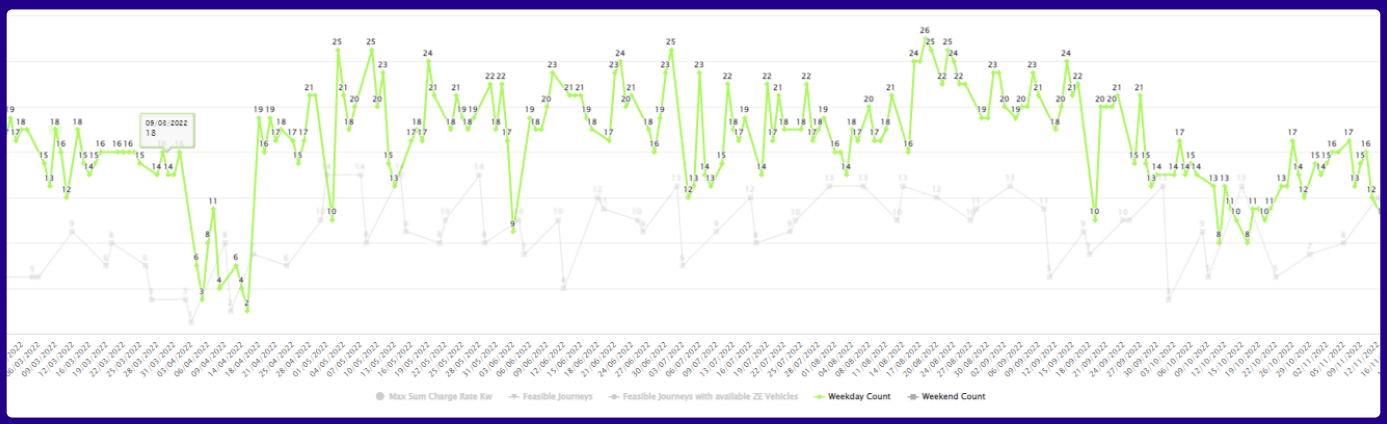


Figure 1: Journeys per operating day

This case study focuses on the electrificaiton of the Buckie depot. If the maximum number of vehicles were purchased to cover all journeys that could be electrified then a grid connection of **1050kW** would be required.

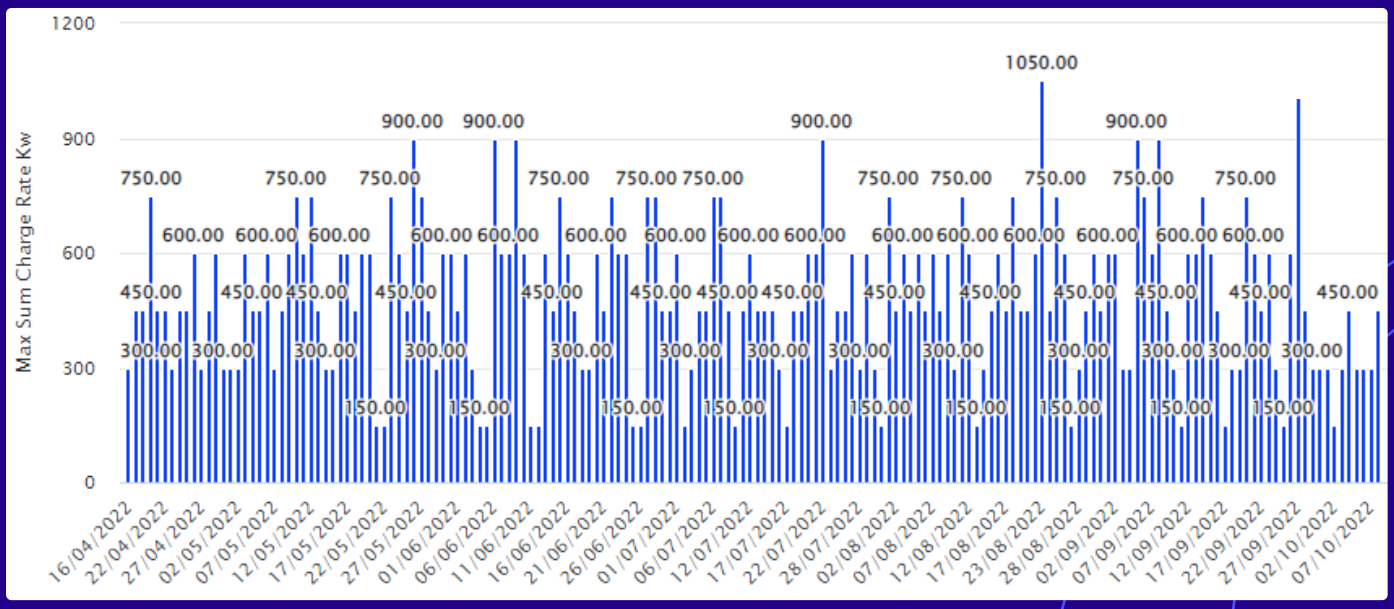


Figure 2: Charge activity (in kW) per operating day (maximum electric vehicles)

3 - Depot

The current supply at Maynes' Buckie depot is registered as 3-phase Non Half Hourly Metered, so no capacity is set but is deemed as handling up to 69kVA. An application has been made to the DNO on the 2nd of February 2023 for a quote to upgrade this connection to 249kVA.

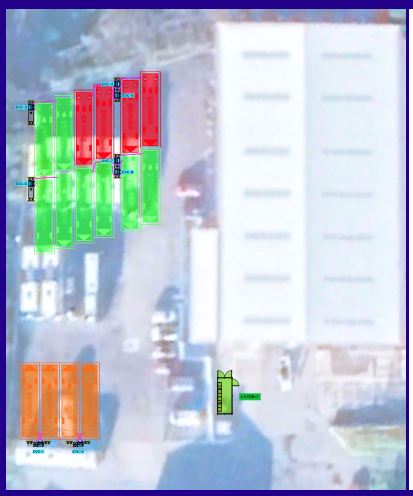
At the time of writing the DNO had not replied so for the sake of this report it is assumed that the grid upgrade will cost £85,000 and can be available in 12 months time.

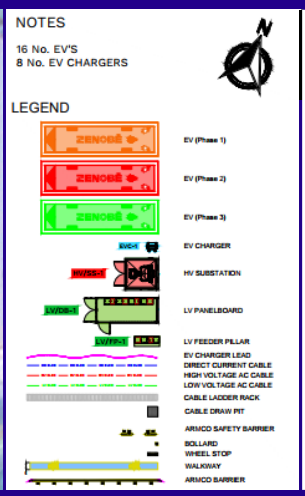
Previous investigation has found that the local HV cable between substations runs directly in front of the Maynes workshop, so it may be possible that a higher connection could be possible for similar cost. A further application will be required to the DNO to establish this which was deemed out of scope of this study due to the the extra costs associated with the application.

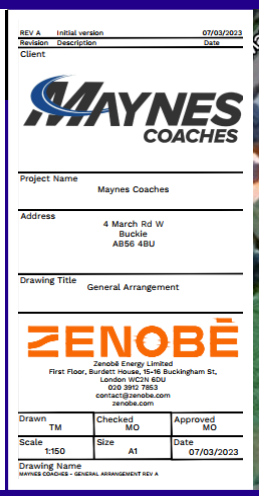
The electricity supplied to the site is the British Gas fuel mix created from nuclear and renewable sources. It is clean energy that produces no carbon emissions. The current cost per kWh is 16.86p. This contract expires March 29, 2024.

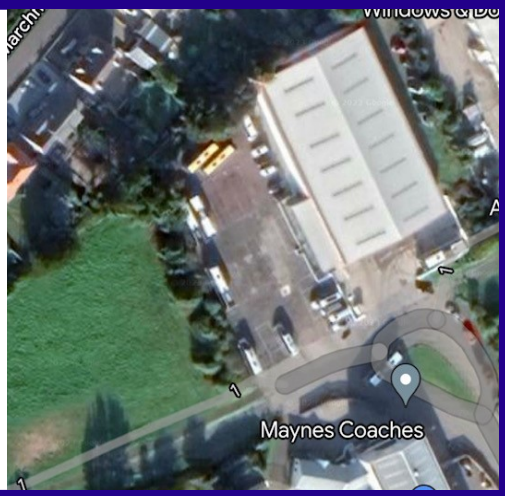
Maynes have been considering the future of the coach industry for some time and In the last 6 months have purchased the adjacent land to future proof itself. The land can be used to make room on the depot for chargers or to host future chargers or a hydrogen refuelling station if that is the next step. Architecture plans are being drawn up and the planning process started.

The diagram below, provided by Zenobe[1], shows the proposed grid layout with a phased approach to installation. The ground site work can be performed at one time to minimise disruption. Ducting can be installed so that cables can be pulled through as required in each phase.









[1] Zenobe; "We design, finance, build and operate battery solutions. Our batteries capture renewable energy, balance its supply on the grid and transport it to electric vehicles. At the end of their lifecycle we repurpose them. We're building a circular economy for batteries, the output from one process can be the input for the next, saving vital materials, carbon and value. Today in the UK, we're the leading owner and operator of battery storage. We are supporting the National Grid with the uptake of renewable power and work with c.90% of the major bus companies, powering 25% of the UK e-bus market."

4 - Phased Approach

Chargers configured to charge at 40kW to keep within the existing grid limit of 69kVa.

Existing chargers powered up from 40kW to 120kW.

Phase 1	4 vehicles	2 twin plug chargers	69 kVA
Phase 2	8 vehicles	4 twin plug chargers	249kVA
Phase 3	16 vehicles	8 twin plug chargers	249-500 kVA

Phase 1

This phase does not require an upgrade to the current 69kVa grid connection, therefore removes any dependency on the DNO.

As can be seen from the utilisation graph below, four vehicles can be utilised fully for almost the entire year. The exceptions largely being weekends and school holidays, that is the typical pattern for Maynes Coaches.

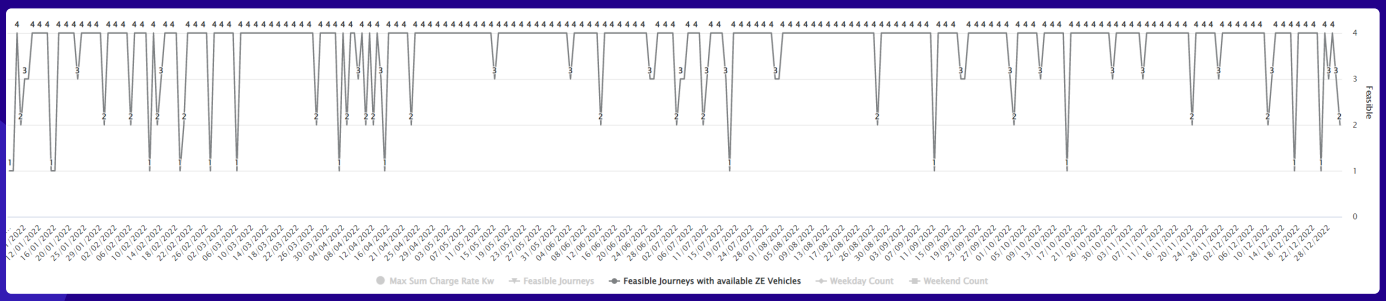


Figure 3: Electric vehicle utilisation (4 electric vehicles)

Rather than buy “suitcase” chargers that will become redundant in Phase 2, two 120kW chargers will be purchased and configured to run at a maximum of 40kW each.

The power draw diagram shows that due to overlap in vehicles charging that consistently the power requirement breaches the 69kVA grid limit and reaches 80kW (4 x 20kW chargers running simultaneously).

Through analysing the data however it is shown that half of the vehicles in these cases can defer their charging moments until the first two vehicles are charged. This is known as smart charging and Zenobe provide charging software and hardware that analyses power usage to the millisecond. This software can manage individual charger power levels to ensure that the established grid limit is respected and that each vehicle is charged in time.

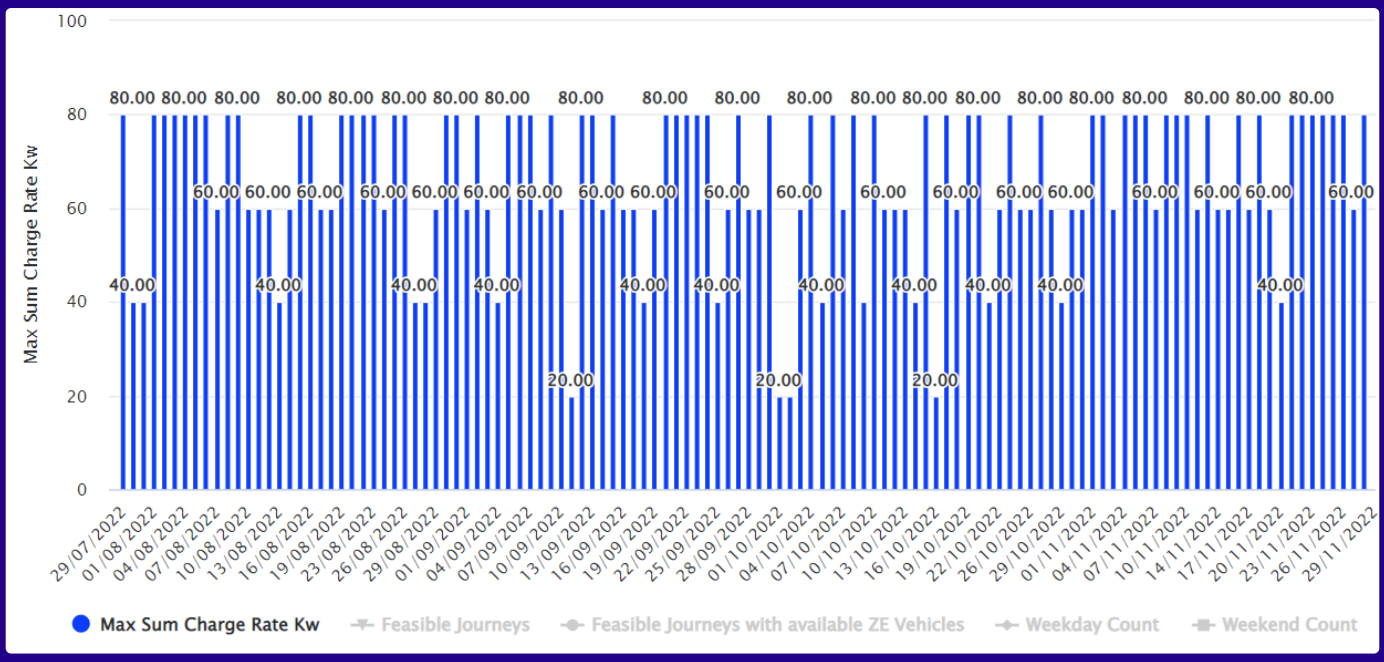


Figure 4: Charge activity (in kW) per operating day (4 electric vehicles)

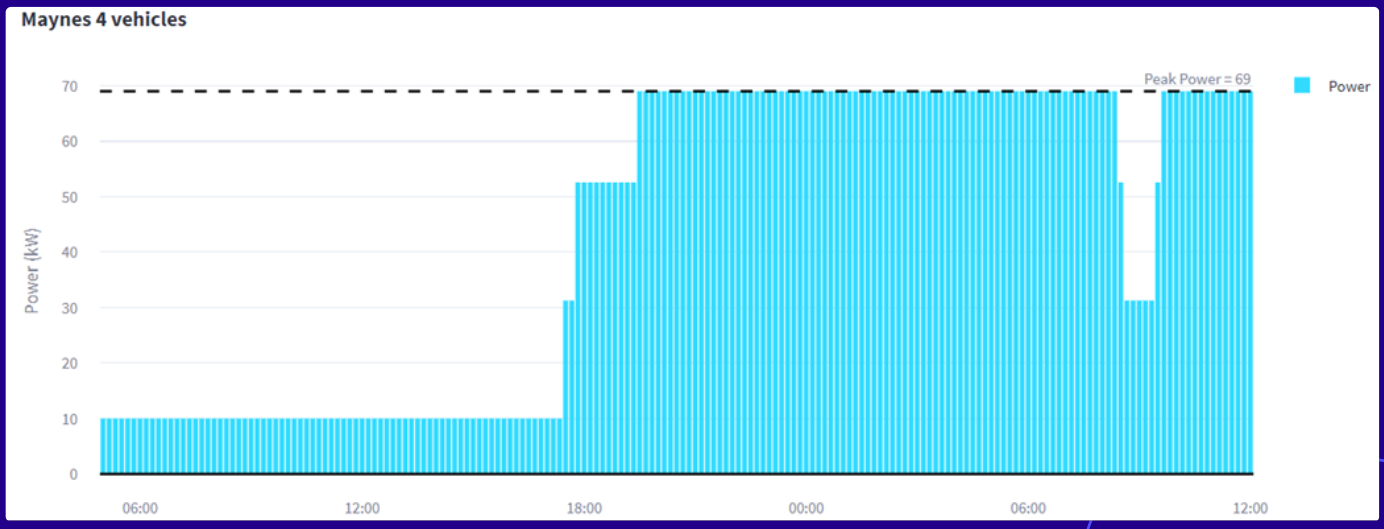


Figure 5: Load balancing (4 electric vehicles)

The alternative without smart charging would be to only have one 120kW charger configured to only deliver 40kW ensuring that 2 vehicles can be charged without breaching the grid connection limit.

Phase 2

This phase involves reconfiguring the existing chargers to charge at their full power rate of 120kW and installing two more 120 kW chargers. The grid connection also needs to be upgraded to a minimum of 249kVA to support the extra charging requirements.

The work profile shows that there will be solid utilisation of 8 vehicles if 2022 levels are repeated, following a similar Monday-Friday high usage pattern as is expected.

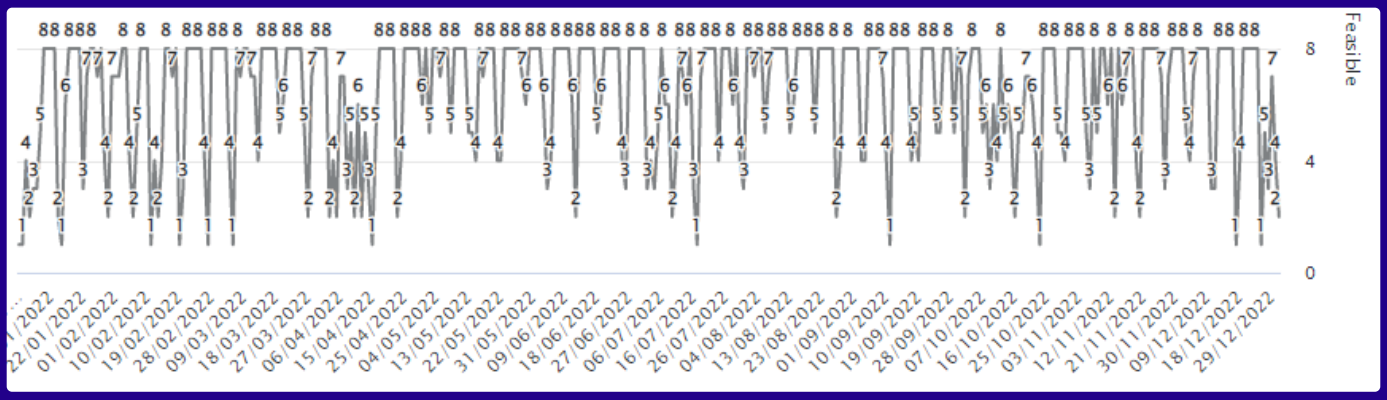


Figure 6: Electric vehicle utilisation (8 vehicles)

The modelling below shows that with this usage pattern at some points of the year the grid limit would be exceeded resulting in some vehicles being unable to charge.

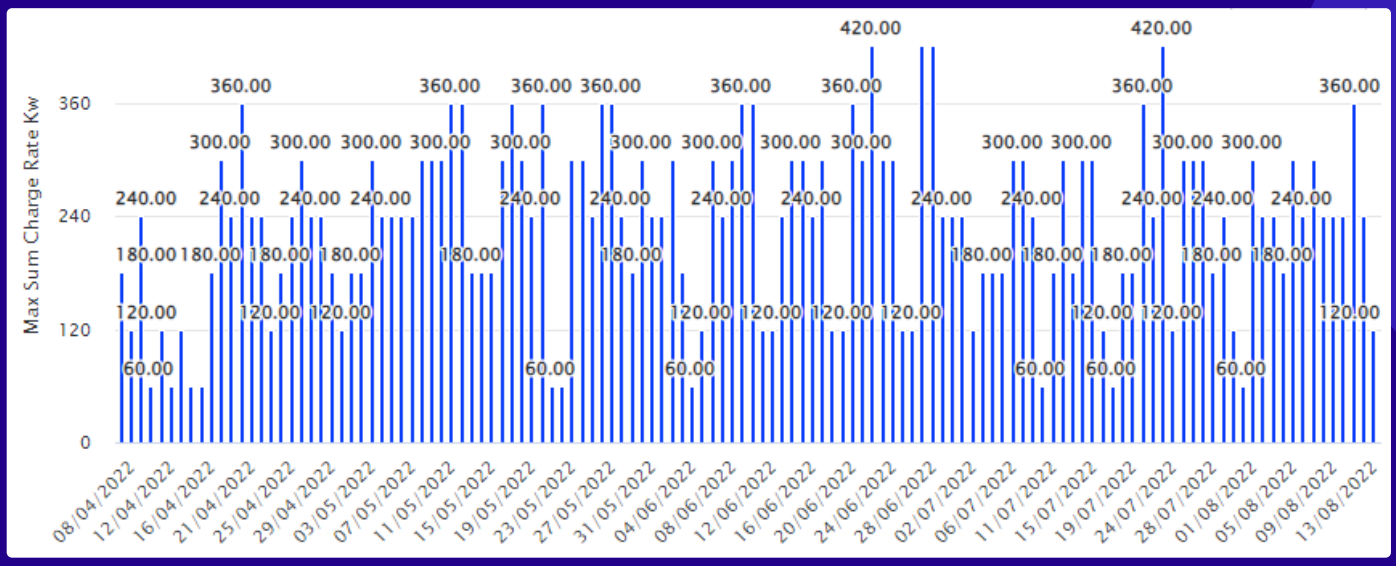


Figure 7: Charge activity (in kW) per operating day (8 electric vehicles)

Again utilising Zenobe's smart charging it will be possible to operate 8 vehicles with the 249kVA grid constraint.

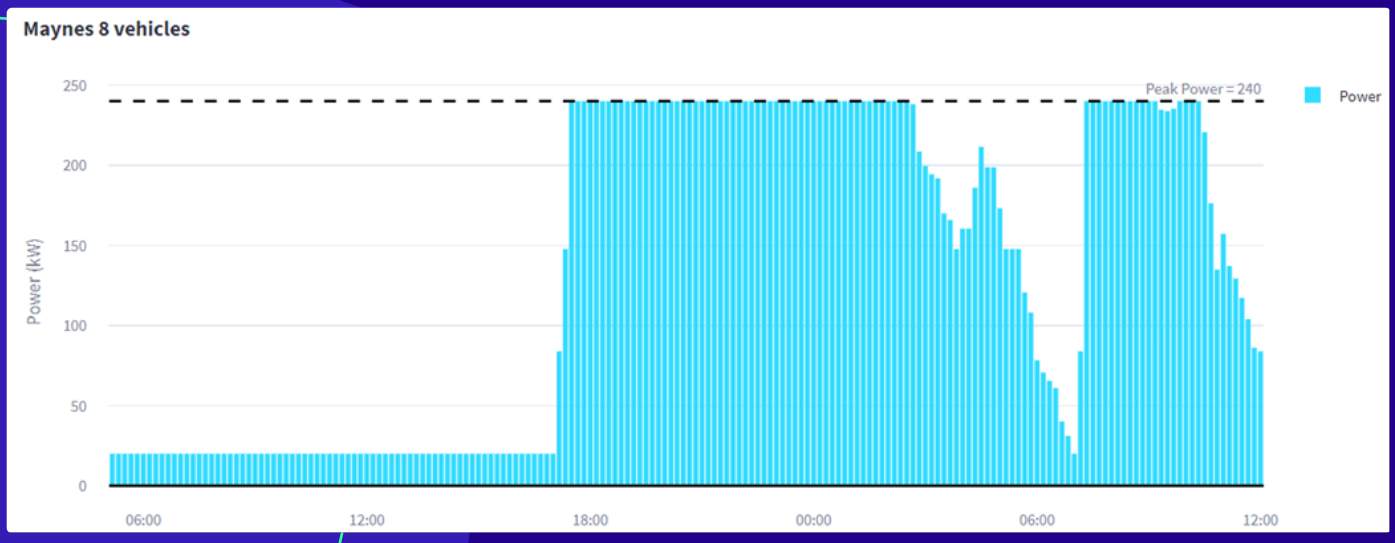


Figure 8: Load balancing (8 electric vehicles)

Phase 3

This phase involves purchasing 4 more chargers to complete the charger rollout and 4 more vehicles bringing the total to 8 120kW twin-plug chargers and 16 vehicles.

To create the extra demand for the new vehicles Maynes will move the contracts run from their Elgin depot to run from Buckie. The contracts in question are based half way between Elgin and Buckie so are suitable for adoption.

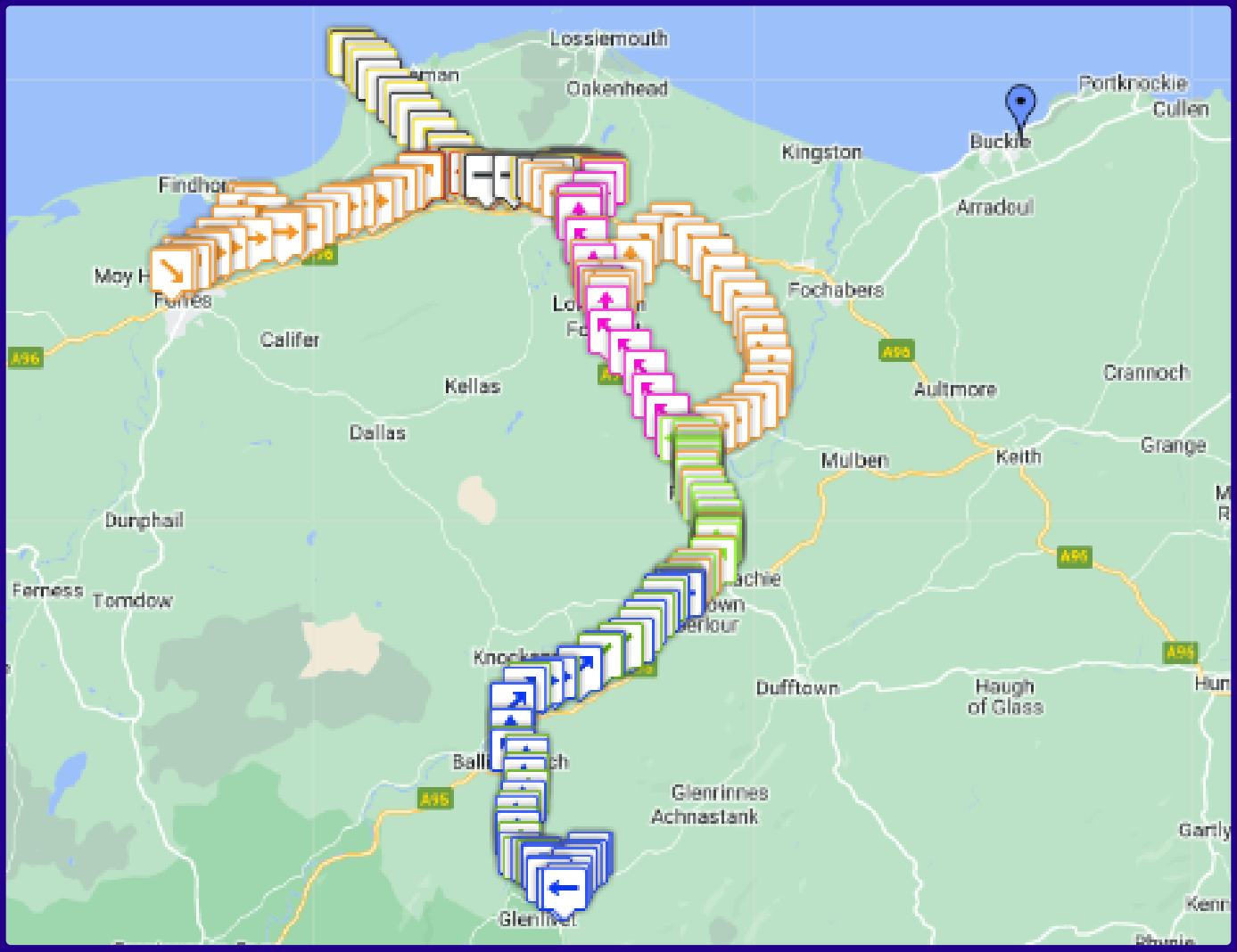


Figure 9: One day activities for a vehicle based out of Elgin

It is estimated that a further grid connection to 350-500kVa will be required to facilitate the extra demand. More information is required from the DNO as to whether this is possible or whether it will cost more than the 249kVA connection already requested.

The best option is to use a higher grid connection if available. If that turns out to be cost prohibitive or unfeasible then it will be possible to use on-site battery storage to boost this capacity.

A solar installation can also be used to help charge the on-site storage battery but this will only be of use to save cost during sunny days. The baseline grid capacity to charge the battery during the day will still be required when the sun is not shining

5 - Business Case

The following high level return on investment calculation uses data from 2022 to calculate KMs that could be driven ZE and multiplies to undersatnd the Opex costs for one year. It shows a **return on investment of 5 years**.

This calcualtion does not take into account the future value of money. It should also be noted that the calculation uses Maynes current contracted electricty rate and not the current available market rate. If the market rate of 35p/kWh is used then the ROI increases to 15 years.

CAPEX

Vehicle cost	£5,600,000
Charger cost	£240,000
Install cost (per charger/vehicle)	£160,000
Grid applications & consultancy	£25,000
Grid upgrade	£85,000
	£6,110,000
Diesel alternative	£3,040,000
CAPEX difference	£3,070,000
Subsidy % for difference	75% £2,302,500
CAPEX total difference	**£767,500**

OPEX

Smart charging software	£16,000
Fuel cost	£103,769
Maintenance cost	£28,760
	£148,529
Diesel alternative fuel cost	£312,050
Diesel alternative maintenance cost	£46,017
	£358,067
OPEX total difference	**£209,538**

ROI 3.1 years

For the calculations in this study the following parameters have been used:

Purchase price Yutong TCE12e	£350,000
Purchase price Diesel equivalent	£220,000
Cost per 120kW Charger	£30,000
Cost to install 120kW Charge	£20,000
Consumption rate for Yutong TCE12e	1.07/km
Consumption rate for Diesel equivalent	0.31 litres/km
Cost per litre diesel	£1.75
Tonnes per km [1]	0.0008308
Trees per tonne CO2 [2]	40

Note the parameters provided are illustrative only and do not represent official quotations from any manufacturer or supplier.

[1] connectedfleet.michelin.com

[2] source encon.eu

6 - Socialisation of charging cost

Moray council have announced their Moray Growth Deal plans to further their Bus Revolution project. The graph below shows that there is spare capacity available for 'opportunity' charging from other operators, including the council.

https://cbwmagazine-com.cdn.ampproject.org/c/s/cbwmagazine.com/new-plan-to-revitalise-moray-bus-services/amp/s

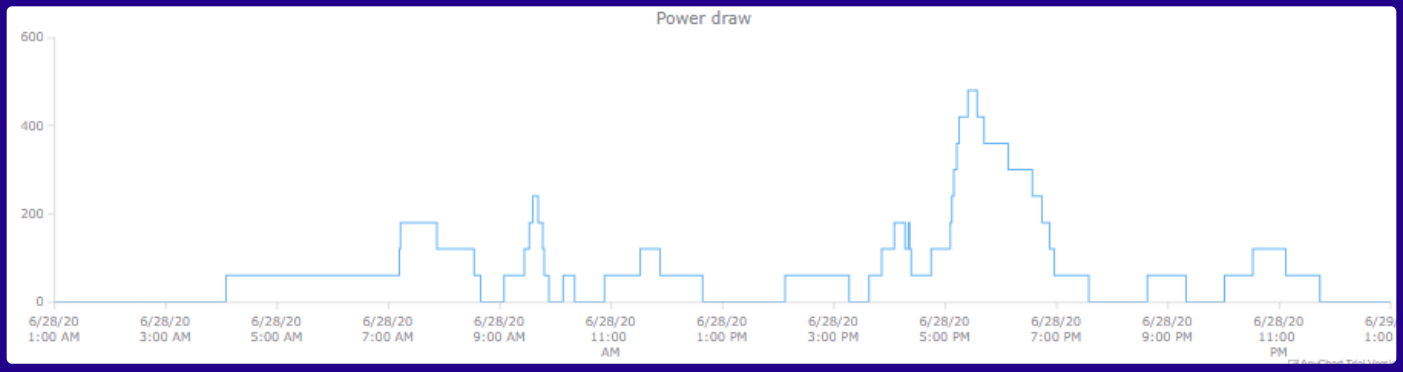


Figure 10: One day power draw

Conversely if Moray council were to make chargers available to Maynes Coaches, especially in the Elgin area then Maynes Coaches could potentially purchase more ZE vehicles without the need to upgrade their grid connection to maximum levels to support the extensive work that they have in the Elgin.

Maynes could also opt to install a charger at their Elgin depot that could be socialised that may negate the need for the highest grid connection rate at Buckie.

These options can be further explored with joint modelling with Moray council if desired.

7 - Conclusion

Maynes Coaches work profile very much suits a significant **transition towards a Zero Emissions** fleet with a large percentage of its business contract based. With intelligent planning they will also be able to supplement the regular scheduled work with ad hoc private hire bookings, further reducing their carbon footprint.

It is well located to be able to establish a suitable power connection with high voltage cabling already present adjacent to their site.

The transition can be a fair one if the difference between investment in electric vehicles, infrastructure and associated installation costs and the cost of diesel vehicle replacement were subsidised by 75%.

Maynes are poised to replace the final 4 Euro 5 vehicles in their fleet with electric vehicles. They would then replace 12 further vehicles over the next 3-4 years.

Including the subsidy this represents a substantial investment of over £4.5m with a return on investment (ROI - not discounted for the future value of money (NPV)) of 3.5 years.

Financial assistance for purchasing the vehicles and infrastructure is seen as the most important factor at this time. Without assistance it would not be an interesting investment to make at this initial stage.

To make this financial commitment without assistance the ZE vehicles available would need to be capable of performing greater mileage so that more activities can be linked.

A note of caution would be in regard to energy prices. Maynes' current tariff expires March 29 2024. If at renewal prices are still high compared to diesel it would represent a significant lengthening in ROI. For example if the price per kWh is 35p then the ROI rises to around 15 years.

Factoring in the future value of money (NPV) and the current cost of borrowing and inflation the proposition would not be commercially viable without a government subsidy that either caps the cost of an electrical unit or links it to the price of diesel so that it is always cheaper by a fixed ratio.

Please note that the financial calculations provided in this report are not quotations and provided as a guide and not be used in a financial application without detailing.

Before proceeding with any application further consideration should also be given to the following that were considered outside the scope of this study:

- Integrated planning with Moray local authorities to investigate sharing infrastructure
- Opportunity charging on route away from depots
- Sensitivity analysis of journeys simulating different consumption efficiencies
- Further analysis of charging utilising the charge curve for the Yutong TCe12

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Energy consultancy experts and leaders in energy transition from our work with the largest providers of zero emission public transport vehicles outside of China including Transdev, National Express and the Go-Ahead group. We have a rich history in the Coach Industry providing finance, compliance, operations and scheduling solutions integrating dozens of industry data sources.

With our deep understanding and experience founded through working with partners such as The Mobility House and PwC and from building financial models, energy models, charging strategies, and understanding battery usage, we help unlock value in zero-emission strategies.

We provide the logic and toolsets to take the risk out of the transition to hydrogen or electric whilst maximising business benefits

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