The optimal number of GTe14 buses to order is 3, according to my optimisation. Also my solution involves using the offered buyback to sell 1 coach of the older model.

The decision being made is about fleet composition, so the decision variables for the model are the number of each model of truck to hold. The objective here is to minimise costs, subject to the constraints that have been described for us, and some common-sense constraints (the number of each coach must be a non-negative integer). The number of trucks must not exceed the number of dedicated drivers available, and the fleet must be capable of handling 185,000 passenger miles (assuming an average of 60% of each coach is filled for both models).

Basic assumptions that are held for linear programming are held for this model, but these may not be true to real life. Proportionality, the assumption that the contribution (to cost, value, etc..) per unit of each variable are the same, would not hold if there are discounts for larger orders of coaches. Additivity, the assumption that the total value for each objective and constraint is found by adding up the contribution from each individual variable[1], may not hold as there might be diminishing returns on the number of miles that it is viable to operate for each additional coach. An additional coach does not necessarily operate to the same capacity as existing coaches.

Some specific assumptions for this scenario include that the TCe12 model has a mileage of 200 miles (the website provided only stated that it can operate above 200 miles, but not how much more). Also, it is assumed that each coach will be 60% full on average no matter what the capacity of the bus is. It is assumed that coaches can charge completely (both overnight and during the day) and work until their battery is depleted every day. Finally, it is assumed that the battery capacity and mileage do not change until or during Summer (due to vehicles aging, wear and tear, etc…).

The solution remains optimal if the compensation given for returning the older models is increased by up to £83,482 or decreased to 0. If the cost of the newer model were to decrease by up to £140,880, the same solution would be optimal. Both constraints are active in the optimisation. If the number of drivers decreases by up to 4 (inclusive), the savings would be £198,000 per driver lost. As the number of miles that must be accommodated increases (by up to 101,944 miles), cost would increase by about £0.03.

Another limitation of this analysis would be that this is very short-term thinking. It does not seem reasonable to sell one functional bus for short term cost savings when BB is planning to expand its operations.

	Updated Fleet	Model	Cost to Buy (£ ,000s)	Buy-Back	Stock	Range (miles)	Seats
Objective	11	TCe12	340	140	12	200	50
	3	GTe12	380	-	0	280	61

Model	Seats	Avg. Seats Used	Cost of Purchases	Coach miles (per day)	Passenger miles (per day)
TCe12	50	30	0	400	12000
GTe12	61	36.6	1140	560	20496

Constraints	1	driver resources	14	<=	14
	2	185,000 passenger miles	193488	>=	185000
	3	integer no. of each coach			
	4	non-negative no. of each coach			

	Total Cost of Purchases	Buyback Compensation	Cost incurred
Objective	1140	140	1000

Figure 1: Model Set-Up for Optimisation

[1] Definitions of Proportionality and Additivity from: https://www.uky.edu/~dsianita/300/online/LP.pdf

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B2	No. of Old Model	11.9990584	0	140	82.4824356	1E+30
B3	No. of New Model	2.00094162	0	380	1E+30	140.88

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
D6	Driver Contraint	14	-198.983051	14	1.41666667	4.97384856
D7	Passenger Miles Constraint	185000	0.028248588	185000	101944	17000

Figure 2: Sensitivity Report from Solver