

Garry Birmingham

**First Bus Decarbonisation
Delivery Director**



Context



- First Bus has an ambitious decarbonisation roadmap to grow our business, build capability and employment opportunities.
- We are publicly committed to operate a zero emissions fleet from carbon neutral depots/facilities by 2035.
- First will make no new diesel purchases after 31st December 2022
- We have an ambitious plan to electrify all our vehicle and depots
- Pathfinder Caledonia is the UK biggest DC Rapid charging hub with over 80 DC Chargers and 150 BEVs.
- This presentation sets out our ambitions for the next 24 – 60 Months
- Speed of delivery is dependant on funding and total cost of Ownership and Total cost of operations (TCO)
- We intend complete four 100% EV depots by March 24 starting at Leicester complete in December followed by York, Norwich (1) and Hoeford with over 400 Buses on Order.

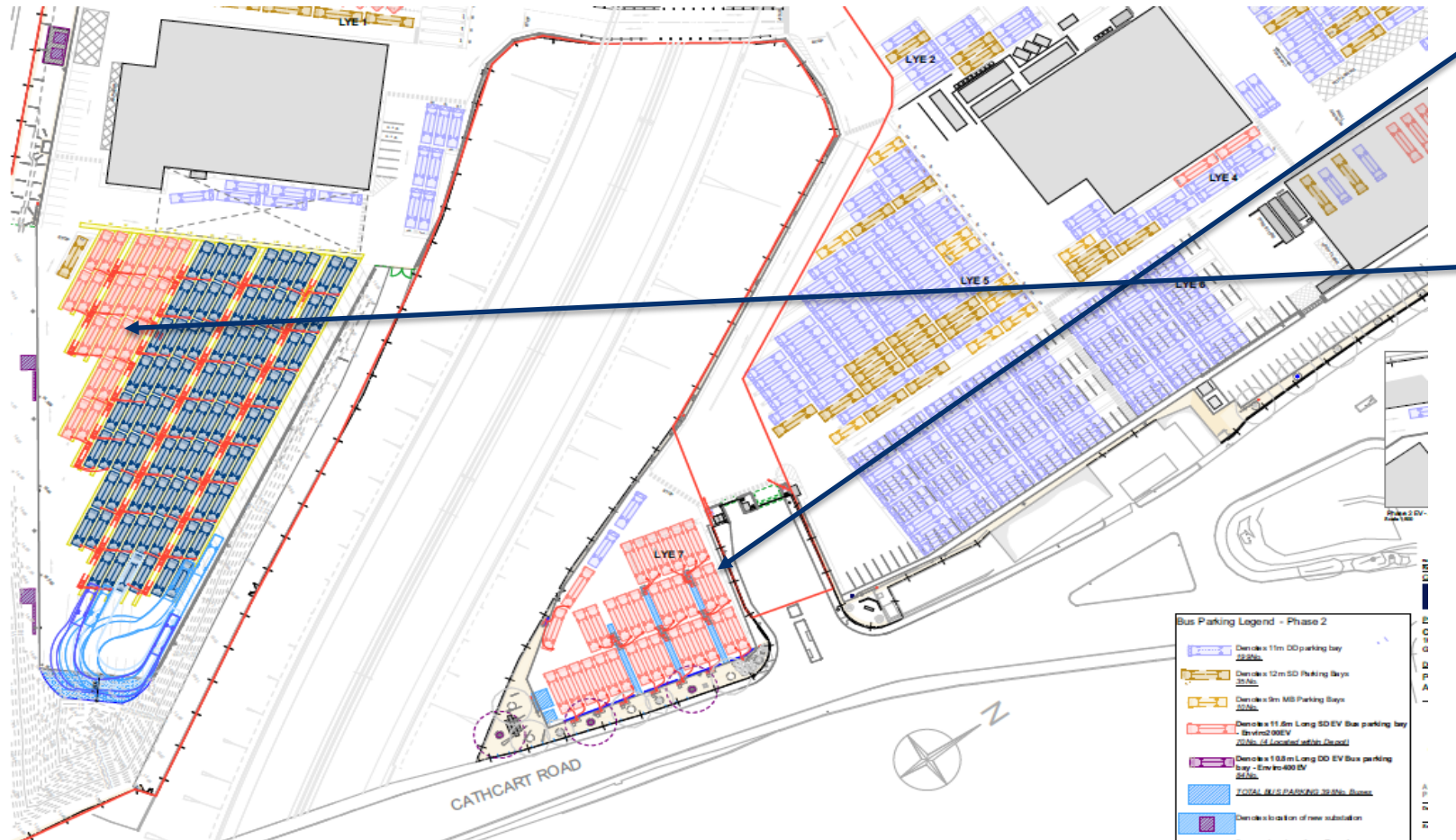


- To be clear this work would not have been possible without the `WANT` of the Scottish Government and the drive of the Transport Scotland team through SULEB 1&2 funding.

Context.

- Caledonia is the largest bus depot in the UK and has a maximum site capacity of 430 ICE vehicles
- Sixteen-acre site spans both sides of the M74 motorway and is 9 years old
- EV Technology solution with onsite overnight charging
- Heliox CCS dual headed 150 DC Chargers
- 150 ADL E200 and E400 EVs
- All civil engineering on site for Phase One was completed Jul - Sep 2021
- Phase 2 vehicles deliveries Dec 2021-Feb 2023
- Phase 2 civil works completed April 22 remaining 69 chargers
- Partnership working with DNO, Hitachi and Heliox
- Trial of B2B charging since September with DPD and Police Scotland
- All 150 EVs now in operation across Glasgow
- A further 50 Buses will be delivered to Scotstoun and a further 24 Buses will be delivered to Aberdeen in the next few months with funding from Scotzeb.

Pathfinder Caledonia – Plan to reality



- Phase on x22 BEV
- Shovel in the ground July 2021.
- Vehicles operational Oct 2021
- Phase 2 Infrastructure complete March 2022
- Last Vehicles delivered early 2023 (126)
- 33KW Sub station completed in February 2023
- UK's Largest Rapid Charging Hub (unintentionally)



ZEB costs/constituent parts

Infrastructure

Offsite infrastructure

Onsite infrastructure
& charger
installation

Onsite charger
commissioning

ZEBs

Purchase, Lease
Options, BAAS

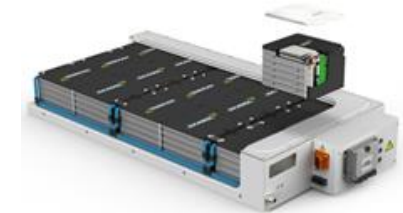
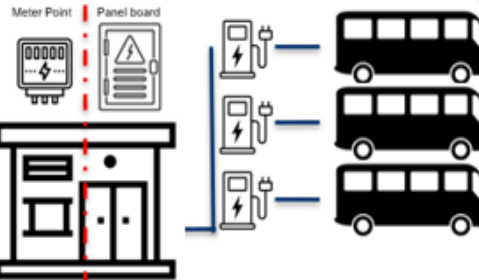
EV telematic
configuration, Smart
Charging

Power to site

Distribution network

HV Sub

LV Sub



ZEB optimisation: volume transition and how we approach the future



Depot power availability

Pathfinder learnings & employee training

BESS Possibilities

Hydrogen, EV, both, dual or triple? EV conversions

Route distances, topography, weather, battery SoH (state of health)

TCO refinement

OEM vehicle ranges by type (SD, DD)

Smart software on and off the ZEB

Site ergonomics /complexity

Chargers, future chargers & how we use space

Future battery technology opportunities

Depot of the future/ planning permissions



Electrification of sites brings with opportunities, however we don't claim to know it all and are still trying to understand and learn with the best knowledge at this time.

Food for Thought!



- The Vehicle Controls the speed of the charge! Bus Max is 110kwh (383kwh Battery)
- The Vehicle can charge at Varying rates 20% - 80% example
- Chargers last for 5-8 years c£40k each.... Minefield
- Smart Charging can really be beneficial both for Power to site but also energy rates
- Driving styles can really effect Range as can Outside Temperature – Heating!
- My Background is international Logistics and Fleet Management – Trucks will have to last longer in your fleets as the asset costs so much more! (Buses live for 16 years on average)
- Battery SOH will be a factor in Lifespan – The future should allow innovation in batteries and repairs to cater for this.
- R&M Deals – Less moving parts- 95% removal of Oils.
- Finally and importantly `TIME` you are not in control! DNO`s or Vehicle Manufacturers

The Rubik's Cube - 1



- **Energy Type and Availability:**
 - Hydrogen
 - Electric
 - Biogas
 - Clean Diesels
 - Back up supply
- **Vehicle availability/suitability:**
 - Range/Route/Topography
 - Battery size
 - Quality
 - Additional software i.e battery telematics
- **Stakeholders:**
 - Internal colleagues (engineering and driver)
 - Local & Central Government
 - Private organisations
 - Investors
 - Local communities
- **Charging Model:**
 - On/Off site
 - Opportunity Charging
- AC/DC
- **Charging Infrastructure:**
 - Power availability
 - Plugs
 - Sockets
 - Charger Type
 - Primary Substation
 - Lifespan of chargers
 - Maintenance of Chargers
 - Charging Management System
- **Depot Location:**
 - Range
 - Routes
 - Energy availability
 - Space
 - Planning requirements

- **Smart Charging:**
 - Grid balancing
 - Grid shaving
 - Variable energy tariffs
 - Fault Management
 - Maintenance
- **Maintenance:**
 - Skills ratios
 - Training
 - Warranties
 - R&M Reduction
 - Vehicle Life – Longer?
 - BAAS????
- **Financial model:**
 - Cost of vehicle, electricity, infrastructure, maintenance, energy, operation
 - Finance and off sheet Balance Trading
- **Safety:**
 - HV Batteries
 - Hydrogen
- **Partnerships:**
 - Turnkey solution
 - B2B/B2C
- **Battery Storage and Generation**

FirstGroup

Our journey to net-zero

We are committed to helping deliver a more sustainable future for the communities we serve and to accelerate the transition to a zero carbon world.



Zero-emission bus fleet by 2035



Supporting Government aim to remove all diesel-only trains by 2040



Setting science based targets for sustainability



Net-zero emissions by 2050 or earlier



First UK public transport operator to sign up to the TCFD guidelines



Signatory to the UN's Business Ambition 1.5 pledge

Questions?