Department for Transport

# Learnings from low and zero emission bus schemes

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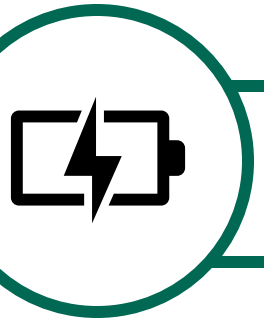
# Overview of today's session



Low emission bus scheme: full monitoring report

ZEBRA interim evaluation report: pre-implementation phase

Success, challenges and lessons learnt from Coventry Electric Bus City

# The Policy Context

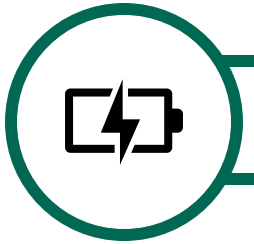
The Low Emission Bus Scheme (LEBS) was a competition run by the Office for Low Emission Vehicles (OLEV) between 2016 and 2017.

£30 million awarded to 13 projects by the Office for Low Emission Vehicles to purchase buses. The 13 winning schemes were announced in 2017. By 2021, 275 LEBs were in service

Four types of low emission bus technologies available: battery electric, diesel hybrid, compressed natural gas and hydrogen fuel cell.

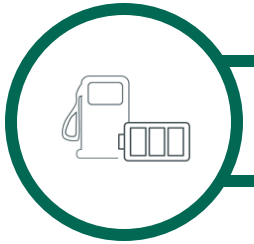
To qualify for LEBS, vehicles needed to produce 15% lower 'Well-to-Wheel' GHG emissions compared to the equivalent Euro V diesel bus.

# Overview of the projects and technologies



Battery electric – 6 projects

CNG (using 100% biomethane procurement) – 3 projects



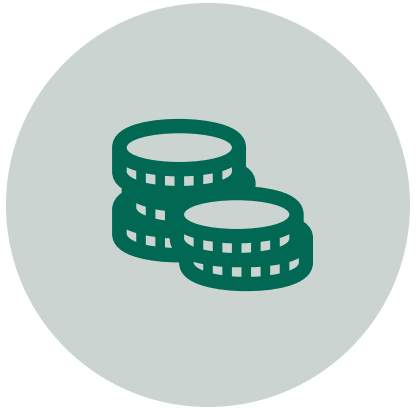
Diesel hybrid – 5 projects


HFC – 1 project I two cities

# Energy Consumption, emissions and fuel cost

AVERAGE ENERGY CONSUMPTION PER KM

GREENHOUSE GAS EMISSIONS PER KILOMETRE: WELL-TO-WHEEL CARBON DIOXIDE EQUIVALENT



ENERGY COST PER KM

- All measures compared to baselines - equivalent standard Euro VI diesel bus

# Comparison between LEBs and diesel baselines

| | Single or Double deck | Energy consumption | WtW $CO_2e$ | Fuel cost |
|---|---|---|---|---|
| Battery electric |  | -59% to -70% | -59% to -70% | -59% to -78% |
| Battery electric |  | -69% to -70% | -69% to -71% | -64% to-66% |
| CNG biomethane |  | +50% | CNG: +13%<br>Biomethane: -80% | -45% to -48% |
| CNG biomethane |  | +33% to +42% | CNG: +1% to +7%<br>Biomethane: -78% | -45% to -48% |
| Diesel hybrid LV |  | -15% to -22% | -15% to -22% | -35% to -41% |
| Diesel hybrid HV |  | -13% to -37% | -13% to -37% | -35% to -55% |
| HFC |  | -55% to -57% | Grid average: -25% to -29% | +10% to +17% |

# Other learnings

Initial reliability challenges reduced over time and were generally comparable to diesel buses by the end of the trial.

Drivers and passengers positive about ride quality and ease of driving. Smooth acceleration, lack of vibration, and quiet ride – particularly electric buses

Optimising driving technique can optimise the fuel efficiency benefits from regenerative braking in battery electric, hybrid and HFC buses

GHG emissions savings expected to increase as electricity is decarbonised and use of renewable hydrogen increases

# ZEBRA interim evaluation report: pre-implementation phase

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# ZEBRA Presentation Structure

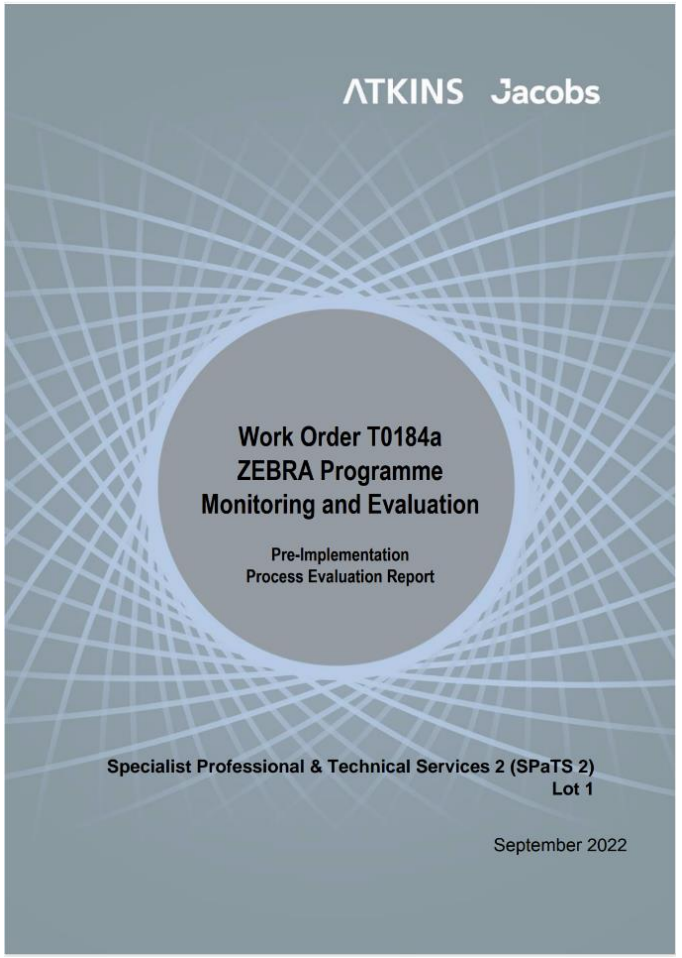
- Evaluation overview
- Scheme overview
- Successful bid characteristics
- Success, challenges and lessons
- Evaluation next steps

# Pre-implementation phase process evaluation

- What can be learned from the bidding and pre-implementation phase of the ZEBRAS scheme?
  - What did and did not work?

- Semi-structured interviews:
  - DfT officials involved in design and management of the programme
  - Zemo Partnership
  - DfT consultants
  - LTA officers – including bus operators at two interviews

- Focus of the presentation on learnings for LTAs and partners



# The ZEBRA scheme

The ZEBRA scheme launched on 30th March 2021.

The (ZEBRA) scheme aimed to support LTAs implement place-based zero emission buses and infrastructure.

The scheme aimed to support government commitments to reduce CO2 emissions from the transport sector and roll out 4000 ZEBs

The scheme aims to support bus manufacturers in developing ZEB technology, and support partnership working between LTAs, operators and other stakeholders.

# Applications and Award

**Phase 1:**
**Expression of interest**

**Phase 2:**
**Full business case**

**Fast track**

**Standard track**

Overall, 35 EOI applications were received, and 23 LTAs were invited to submit full business cases.

£270 million awarded to 17 LTAs to deliver 1,278 ZEBs at time of the award

# Scheme characteristics

**8 small schemes** (<50 vehicles)
**3 medium schemes (**50-100 vehicles)
**6 larger schemes** (>100 vehicles)

**10 schemes complete/near complete replacement of depot fleet**

**Cost range:**
**£6.8 million (Norfolk)**
**£86.7m (West Midlands)**

**Most focused on commercial services and urban routes**

**Most worked with a single operator**

**This is a broad overview of ZEBRA at the time the report was written in September 2022. Since then, there have been some changes to some schemes**

# ZEB technology


11 battery electric with depot charging

*Photo: Arrival's purpose-built electric bus, which is being considered for many schemes (Source: York Business Case)*


5 battery electric with depot and opportunity charging

*Opportunity trial on Kent's Fastrack network (Source: Kent Business Case)*

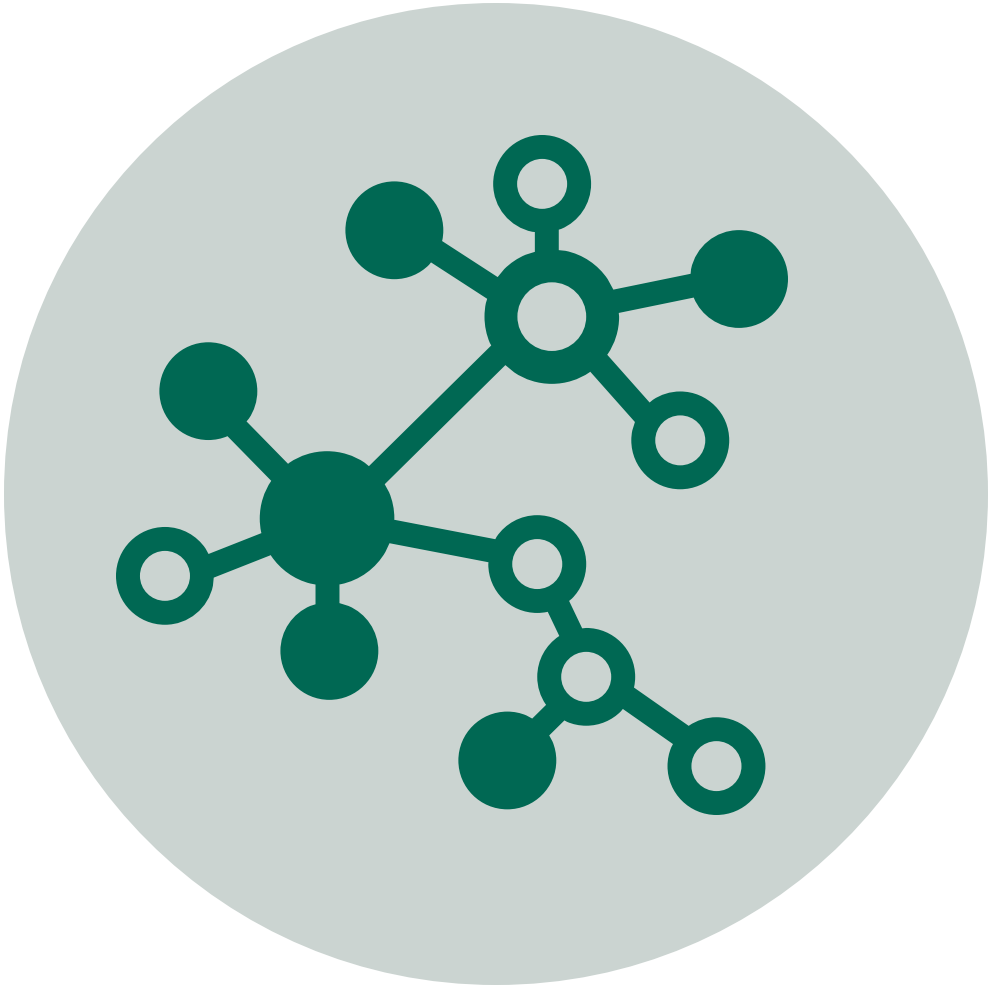

1 using hydrogen fuel cell technology

*Right: One of the 20 existing hydrogen buses in the West Midlands, purchased as part of the Council's Clean Air Hydrogen Bus Pilot (Source: TfWM)*

# Successful bid characteristics

# Strong relationships with operators

- Successful bids often had strong relationships with operators
- Many already committed to transition to zero emission fleets and already started to develop partnerships with manufacturers and suppliers.
- Operators' connections to manufacturers or energy suppliers were often thought to enhance bids.



# Clear vision

- Successful bids were able to demonstrate a clear vision:
  - How the scheme would fit with wider plans to decarbonise the bus fleet
  - How the scheme would contribute to wider local area transport and decarbonisation objectives
  - Future-proof
- Better able to demonstrate deliverability and ambition

# Capacity and capability - skills mix

- Successful bids had access to the right skills mix:
  - In-house
  - Delivery partners
  - Consultants

- Highlights importance of relationships and partnership plans

# Complexity

- Very important to have clear justifications for more complex schemes

- Requires clear descriptions of rationale for and approach to risk of the complexity:
  - Route
  - Technology
  - Infrastructure

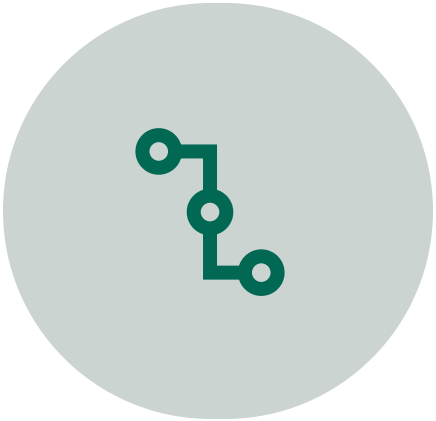
- Tends to be more work involved in justifying more complex schemes

- However, they can be successful!

# Successes and challenges

# LTA pre-implementation – success and challenges

**Partnership working**



**Energy supply**

**Legal requirements**

# Lessons for LTAs

- Develop the strategic case for the scheme
- Make sure the right skills and resources are in place – technical, legal, financial, procurement
- Engage with operators early
- Use GBT for optioneering and helping to understand what is driving BCR
- Engage with energy supplier
- Clear justifications – complex schemes require more work to justify

# Evaluation next steps

## Impact evaluation

- To assess **whether** and to **what extent** the programme has met the intended objectives:
  - Monitoring data collection – understand progress on key outputs and outcomes
  - Baseline data collection – understand what was happening before
  - Case studies – interviews with stakeholders
- Interim report early 2025
- Final report 2026

## Process evaluation: implementation and operation

- To assess how and why the schemes do or do not work – particularly useful where there is variance in scheme design
- Timing tbc but report likely early 2025

# AEBT presentation

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# Thank you for listening

# Any questions?

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# Coventry Electric Bus City

Eliot Wilde – Transport for West Midlands

17th October 2023

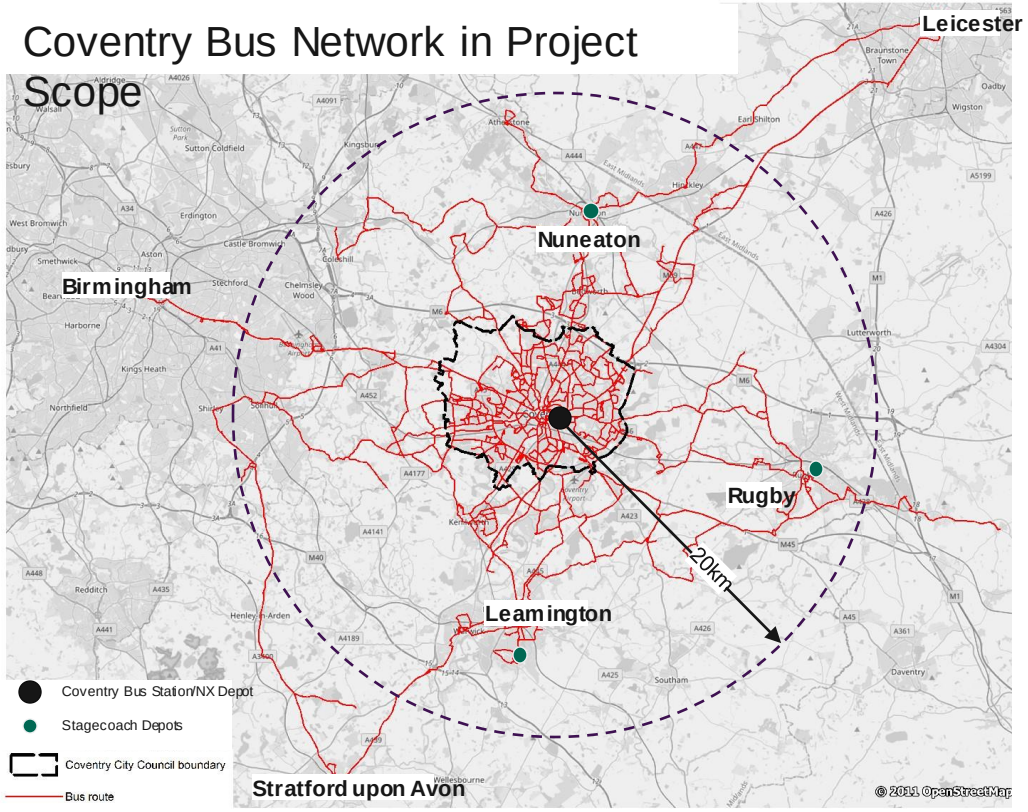
tment for Transport

# Project Overview

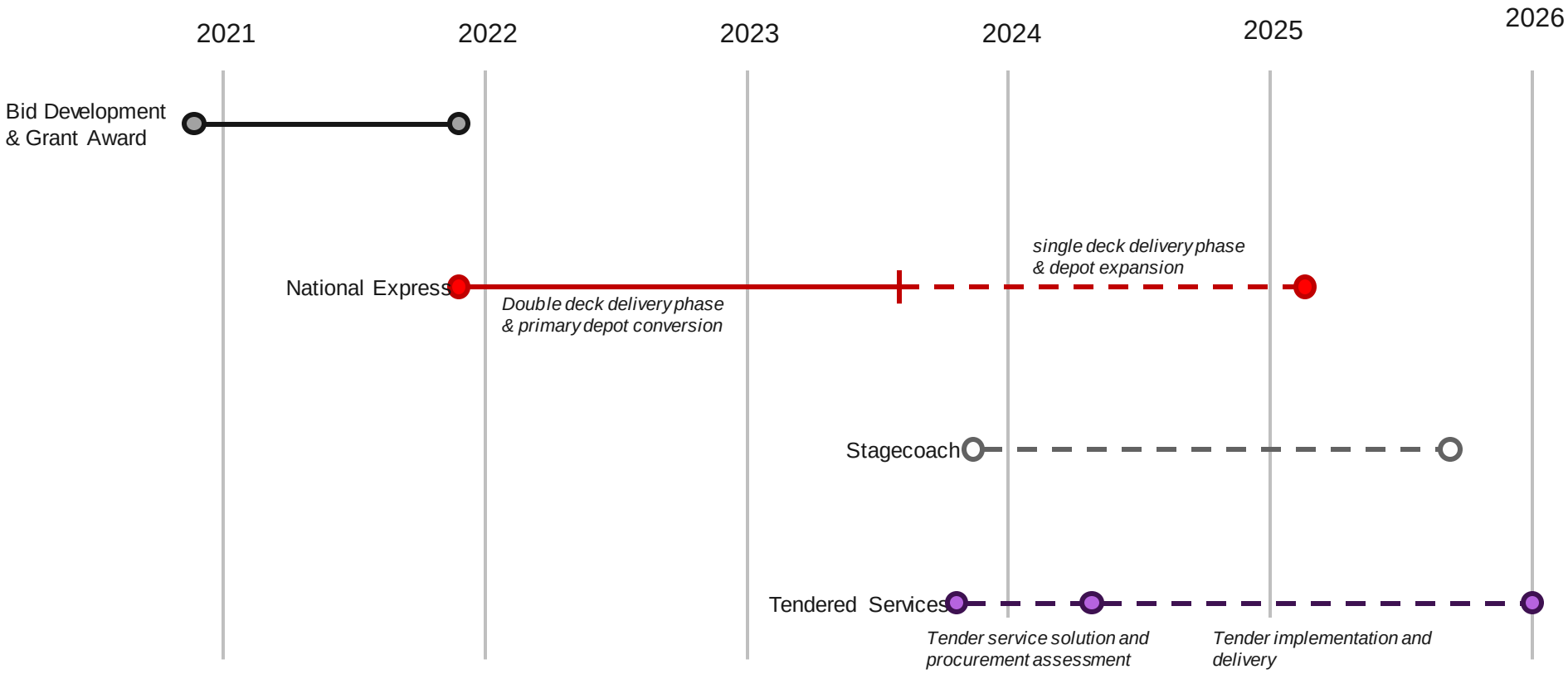
- ***All vehicles operating on local bus service that run in Coventry must be battery electric by December 2025.***

| | | |
|---|---|---|
| Total Bus Parc 255 | 4+ Depots | 40 Routes |
| £50m DfT Funding | £100m Operator Investment | £5m Local Authority Funding |

Coventry Bus Network in Project Scope



# Timeline and Progress



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# Technical Delivery Challenges

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# Depot Conversion

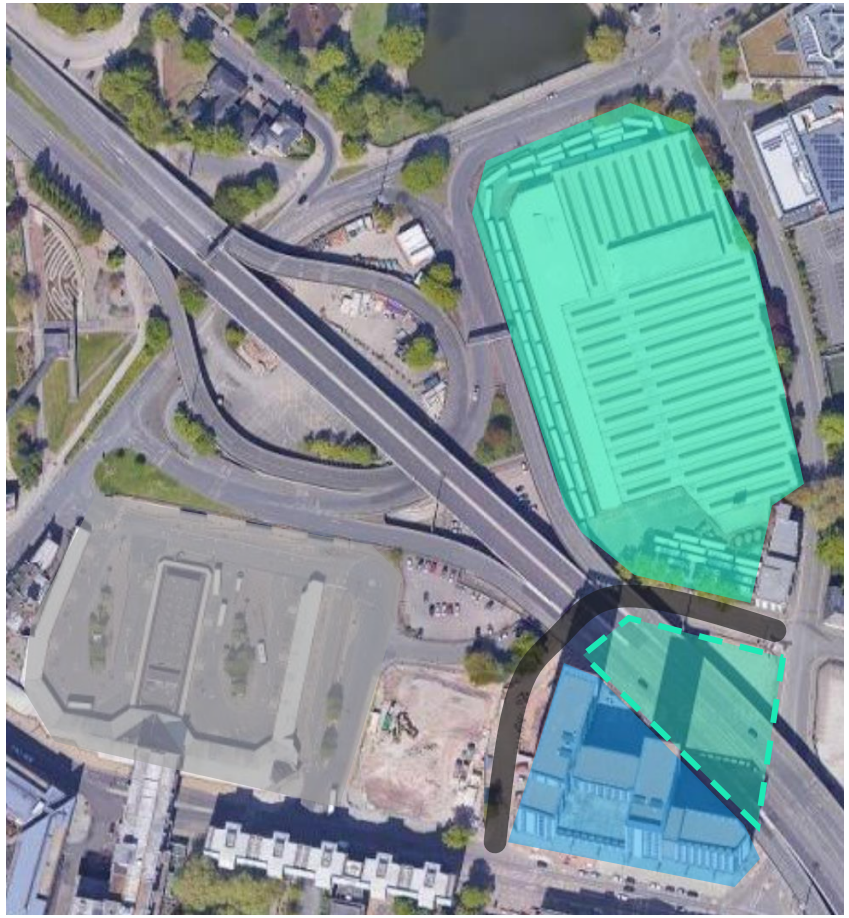
*The National Express Coventry depot – a tram shed from the 70s – has been fully converted for battery electric buses.*

- **Key Challenges**
- **Layout reconfiguration**
- **Cable routing**
- **Equipment protection**
- **Depot capacity**

# Land & Legal

*The conversion of National Express primary site has been challenging in itself, but the required expansion has created further complexity.*

- **Key Challenges**
- **Multiple parties in land and leasing arrangements.**
- **Access and land rights**



# Power

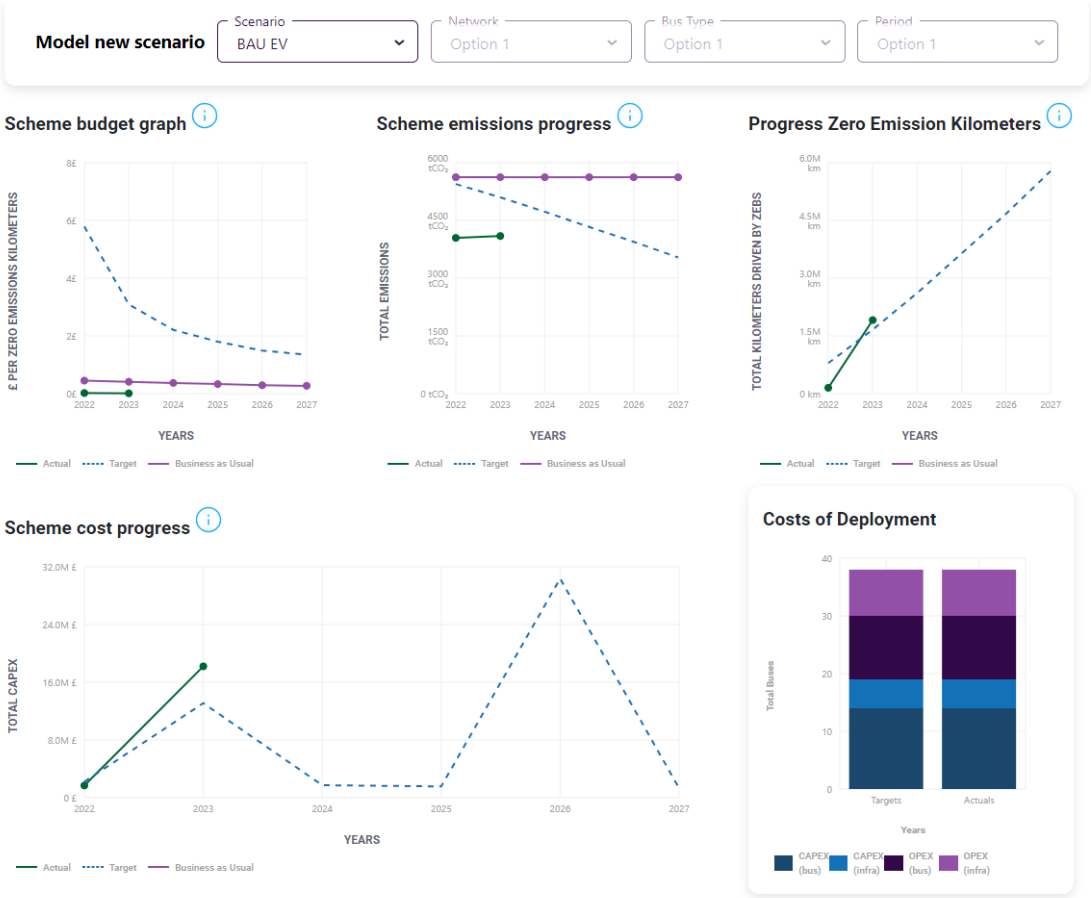
- Planned 10MW private wire connection to support National Express depot and opportunity charging at bus station.
- National Express decided to pursue their own connection with DNO – 6MW available from local distribution grid.
- National Express Will require active charging management to maintain demand below capacity.
- Implementation challenges at the point of full go-live.
- No constraints for Stagecoach depots but power demand at each site much lower.

# Vehicles

- The success story of the project!
- National Express fleet - ADL BYD Enviro400EV, AC Charged
- Early indications show vehicles performing better than expected on performance, range and reliability.
- Positive feedback from passengers as well as drivers.

# M&E and Data

- **Extensive data gathering to assess vehicle, route depot and project level performance and outcomes.**
- **Challenges in integrating data form AVL, vehicle energy systems and chargers.**



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# Role of TfWM & Strategic Challenges

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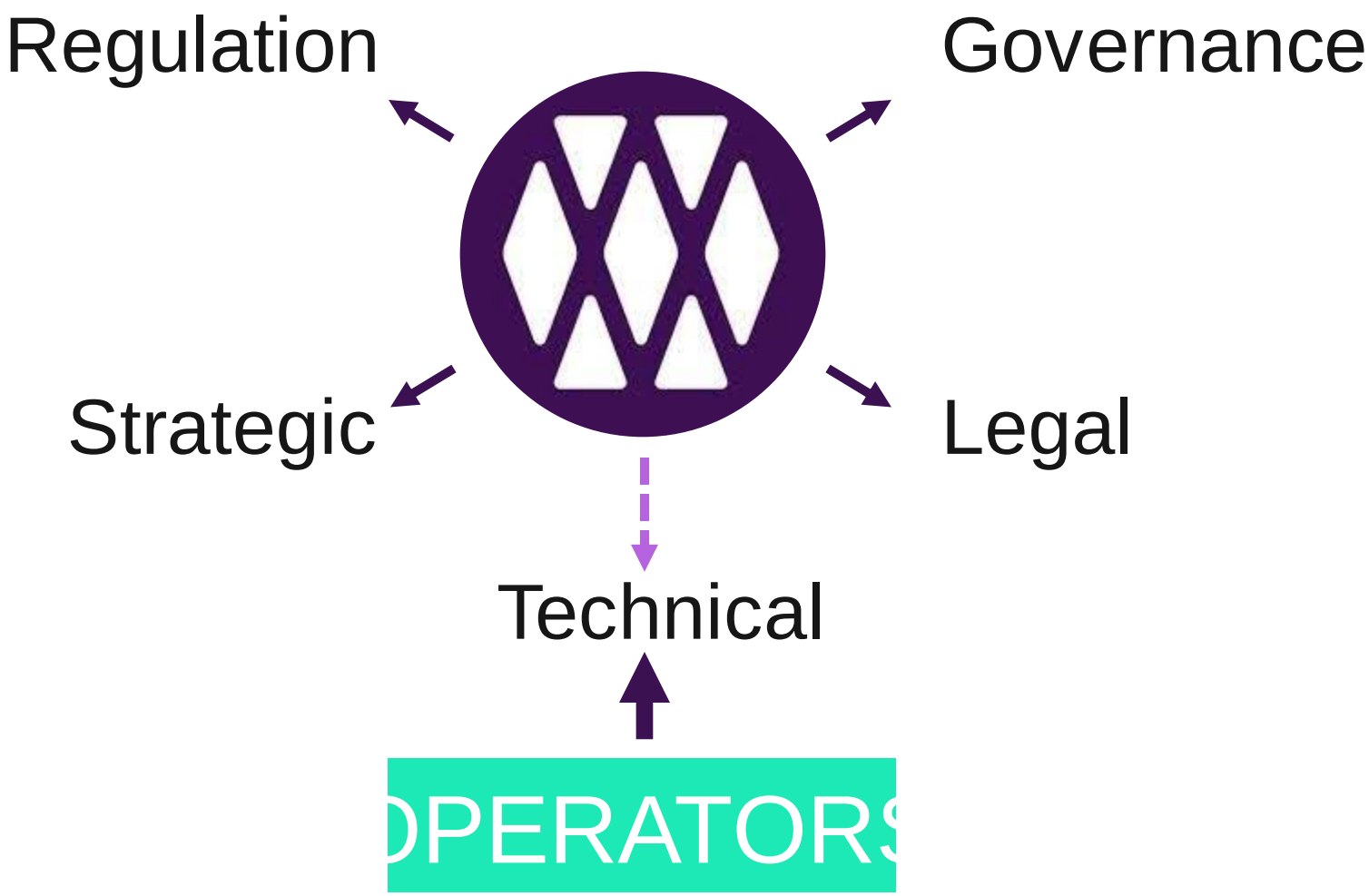
# Role of TfWM


Regulation
Governance
Strategic
Legal
Technical
OPERATORS

# Strategic & Regulatory Context

- National Express are almost a Monopoly operator in the West Midlands with ~95% market share.
- National Express the only operator with a depot within or close to Coventry.
- TfWM has been undertaking franchising assessment in parallel with the delivery of Coventry Electric Bus City.
- The combined effects of the Covid-19 pandemic and inflationary crisis has put significant strain on operator finances.
- Ambition for a 100% Zero Emission bus fleet by 2030.

# Key Challenges for TfWM

- Enforcement of the “electric bus city”.
- Programme impact of implementing BSIP and ongoing developments Enhanced partnership.
- Protecting and retaining publicly funded assets supplied under commercial leasing contracts.
- Maintaining competition in a deregulated environment.
- Navigating the state aid and subsidy control.
- Future proofing ZEB solutions.