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National Transport Authority

Ireland's Transition to Zero-Emission Public Bus Services

EV Summit & Expo 2024
14th Nov 2024

Buses and Coaches - what is the difference?

- Both buses and coaches are used to provide public bus services throughout Ireland
- Buses are typically classified as vehicle category M3 Class I according to EU/UNECE Regulation No. 107 (Uniform Provisions concerning the approval of Category M2 or M3 vehicles with regard to their General Construction), which pertains to vehicles constructed with areas for standing passengers, to allow frequent passenger movement
- Coaches are typically classified as vehicle category M3 Class III according to EU/UNECE Regulation No. 107, which pertains to vehicles constructed exclusively for the carriage of seated passengers
- This distinction is important as, amongst other differences, coaches are not yet subject to the quotas contained within Directive (EU) 2019/1161 of the European Parliament and of the Council of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles, which is better known as the Clean Vehicles Directive or 'CVD'

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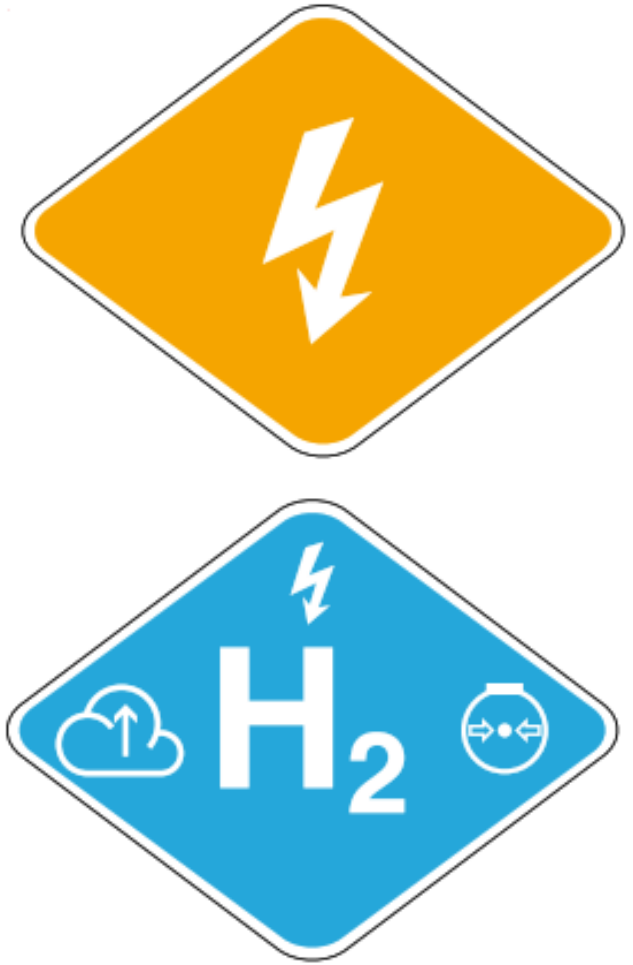
What is a Zero-Emission Bus?

- The CVD currently only applies to M3 Class I vehicles (so buses, but not coaches)
- In the CVD, a "**clean vehicle**" means a vehicle of category M3 […] using alternative fuels as defined in points (1) and (2) of Article 2 of Directive 2014/94/EU […]
- And a "**zero-emission** heavy duty vehicle" means a clean vehicle […] without an internal combustion engine, or with an internal combustion engine that emits less than 1g CO_2/kWh […]
- Other than a trolleybus or a bus equipped with an opportunity-charged capacitor-based powertrain or similar, only a M3 Class I vehicle equipped with a battery-electric powertrain or a fuel-cell-electric powertrain qualifies as a Zero-Emission Bus under the CVD



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Urban Public Bus Fleet Transition Strategy

- In March 2021, the NTA Board endorsed a strategy for the transition of Ireland's urban bus fleet to zero-emission M3 Class I vehicles
- Transition strategy is based on steady state replacement of urban buses at 12 years of age
- This is intended to result in the withdrawal of all diesel-only urban buses from the public bus fleet by 2032 (i.e. 8 years from now)
- It is also intended to result in the withdrawal of all hybrid urban buses from the public bus fleet by 2035 (i.e. 11 years from now
- An indicative transition timeline for each of the largest cities in Ireland is shown at right

	Total Buses (2023)	2023	2025	2030	2032	2033	2035	Total Buses (2035)*
Dublin	1243							1489
Cork	129							258
Limerick	40							85
Galway	40							64
Waterford	27							32

*potential growth in overall fleet associated with on-going enhancement of bus services

Diesel Hybrid Zero Emission

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Single Deck Battery-Electric Buses

- In June 2021, the NTA entered into a framework agreement for the supply of single deck long-length battery-electric buses with Alexander Dennis
- Two orders for a total of 55 buses have been placed to-date, inclusive of 11 buses to enable zero-emission operation of the Athlone town bus service
- These ADL-BYD Enviro200EV buses are based on proven technology but tailored to the specific needs of the NTA in providing excellent accessibility, separate wheelchair and buggy spaces and a high level of comfort for both the passengers and the driver
- Each bus is fitted with BYD Lithium Iron Phosphate (LFP) traction battery packs with a total energy of 348kWh and a usable energy of 266kWh after 6 years of service, powering two hub-mounted traction motors fitted to the rear axle

Athlone Town Bus Service Electrification

- Ireland's first 100% zero-emission town bus service and one of the Irish Government's Pathfinder Programme of exemplar transport projects
- Official launch took place on 20th January 2023, with services commencing on 29th January 2023
- Bus Éireann's (BÉ's) Athlone Depot has been equipped with 9 x 150kW charging stations outfitted with a total of 18 charging guns
- 11 x ADL-BYD Enviro200EV buses were supplied to BÉ to enable the conversion of Athlone town bus routes A1 and A2 to zero-emission operation
- Significant growth (<20%) in passenger numbers experienced to-date

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Double Deck Battery-Electric Buses

- In March 2022, the NTA entered into a framework agreement for the supply of double deck battery-electric buses with Bamford Bus Company (Wrightbus)
- Three orders for a total of 341 buses have been placed to-date, of which 220 buses are currently intended for use within the Dublin Metropolitan Area and 121 buses are intended for use in Limerick, Galway and Cork
- As with the single deck buses, these StreetDeck Electroliner buses offer excellent accessibility, separate wheelchair and buggy spaces and a high level of comfort for both the passengers and the driver
- Each bus is fitted with Forsee ZEN SLIM Nickel Manganese Cobalt (NMC) traction battery packs with total energy of 454kWh and usable energy of 350kWh throughout the first 6 years of service, powering a single traction motor coupled to the rear axle

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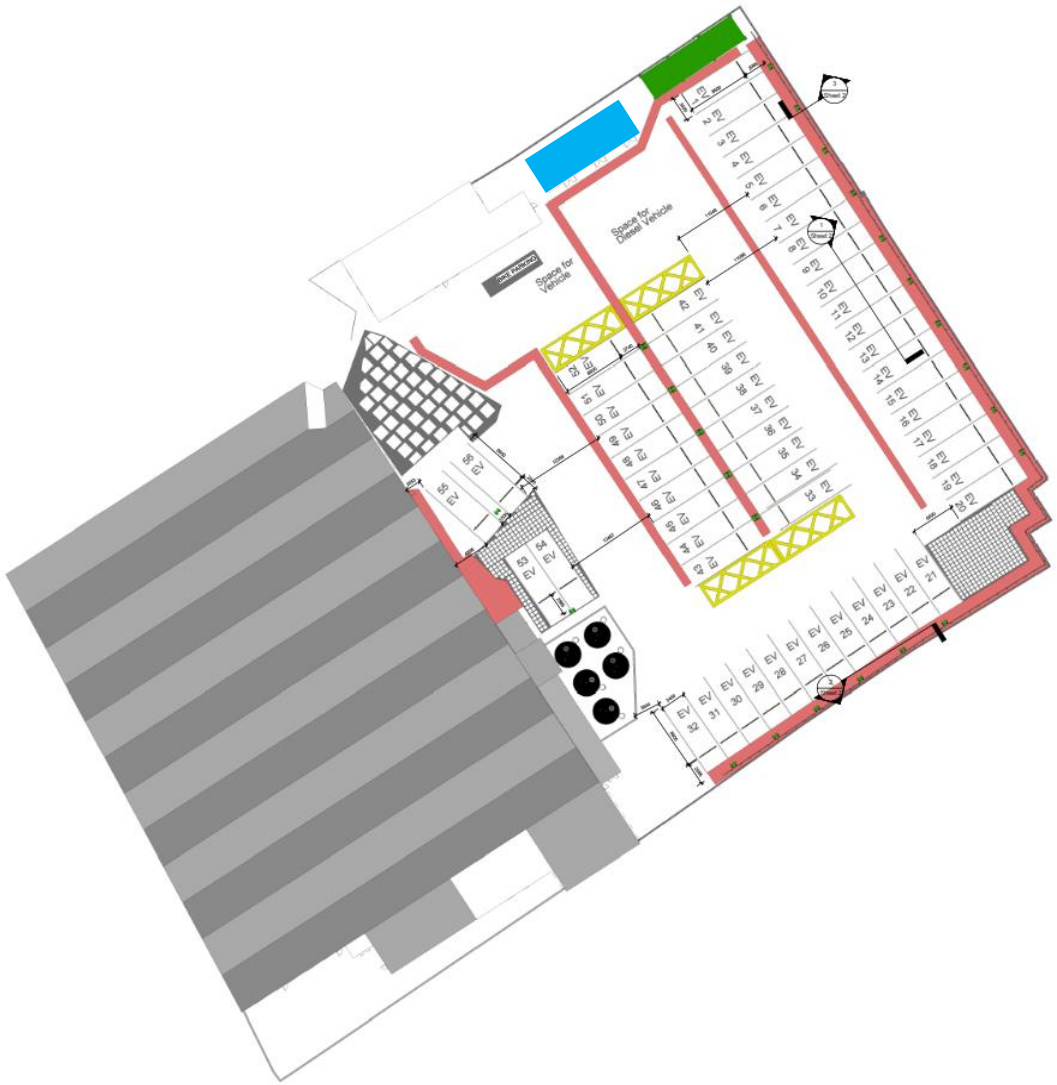
BÁC Depot Electrification - Summerhill Ph.1

- Bus Átha Cliath-Dublin Bus (BÁC) commissioned the initial phase of charging infrastructure at Summerhill Depot on 19th November 2023, which will support a minimum of 56 battery-electric buses
- A substation has been built along the northern boundary of the depot (represented by the blue rectangle) and is supplied via a 1.874MVA Maximum Import Capacity (MIC) connection
- The charging infrastructure was supplied and installed by Hitachi Energy and is primarily composed of:
  - 1 x 'e-House' concentrating the majority of the power conversion equipment within a single structure (represented by the green rectangle)
  - 28 x charging pedestals each outfitted with 2 charging guns that permit a single bus to be charged at up to 150kW or a pair of buses to be charged at up to 75kW



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BÁC Depot Electrification - Phibsboro Ph.1

- BÁC commissioned the initial phase of charging infrastructure at Phibsboro Depot in January 2024, which will support the charging of a minimum of 80 battery-electric buses (inclusive of up to 34 single deck buses)
- A substation has been built along the northern boundary of the depot (represented by the blue rectangle) and is supplied via a 2.698MVA MIC connection
- The charging infrastructure was supplied and installed by Hitachi Energy and is primarily composed of:
  - 2 x 'e-Houses' concentrating the majority of the power conversion equipment within a single structure (represented by the green rectangles)
  - 40 x charging pedestals each outfitted with 2 charging guns that permit a single bus to be charged at up to 150kW or a pair of buses to be charged at up to 75kW

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BÁC Depot Electrification - Phibsboro Ph.2

- Works are ongoing at Phibsboro Depot to provide a further 10 x charging pedestals each outfitted with 2 charging guns
- These additional charging guns will be supported by a 1MVA increase in the MIC, meaning that the substation will soon be supplied by a 3.698MVA MIC connection
- It is currently expected that this enhanced battery-electric bus charging infrastructure will be commissioned during Q1 2025
- Phibsboro Depot will then be capable of supporting the charging of a minimum of 100 battery-electric buses (inclusive of up to 34 single deck buses)

BÁC Depot Electrification - Harristown Ph.1

- Works are also ongoing at Harristown Depot to provide 20 x charging pedestals each outfitted with 2 charging guns along the eastern perimeter of the site, with Wills Bros as the main contractor
- As at Summerhill and Phibsboro Depots, the charging infrastructure will be supplied and installed by Hitachi Energy and each pedestal will permit a single bus to be charged at up to 150kW or a pair of buses to be charged at up to 75kW
- This initial phase of charging infrastructure at Harristown Depot will support a minimum of 40 battery-electric buses
- The charging guns will be supported by a 2.135MVA MIC connection and are currently expected to be commissioned during Q4 2025

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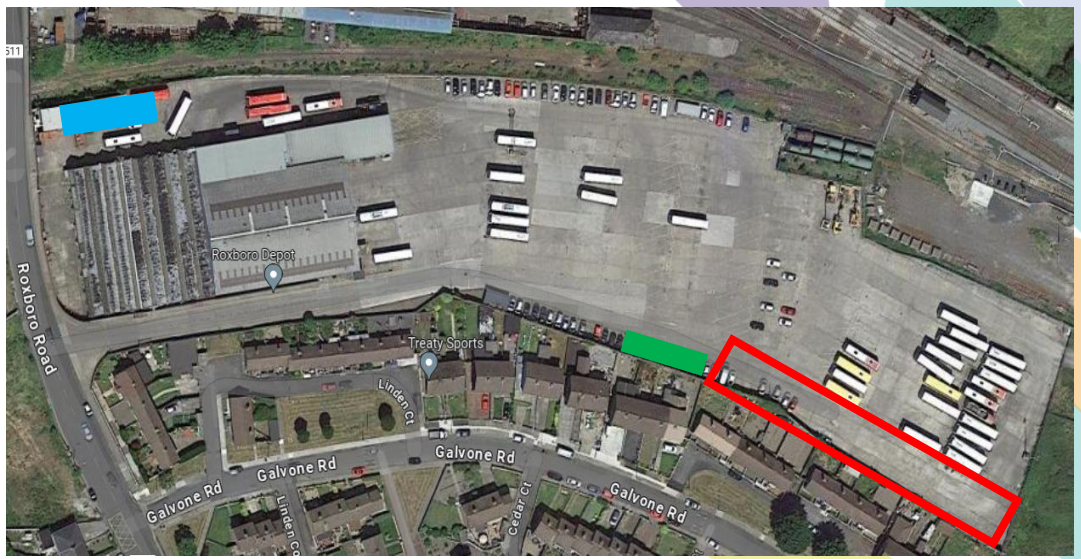
BÉ Depot Electrification - Limerick Roxboro Ph.1

- BÉ commissioned the initial phase of charging infrastructure at Roxboro Depot in Limerick in February 2024
- This initial phase will support the charging of 34 battery-electric buses
- A substation has been built at the north-western boundary of the depot (represented by the blue rectangle) and is supplied via a 4.5MVA MIC connection
- The charging infrastructure is being supplied and installed by Hitachi Energy and is primarily composed of:
  - 1 x ‘e-House’ concentrating the majority of the power conversion equipment within a single structure (represented by the green rectangle)
  - 15 x charging pedestals each outfitted with 2 charging guns that permit a single bus to be charged at up to 150kW or a pair of buses to be charged at up to 75kW



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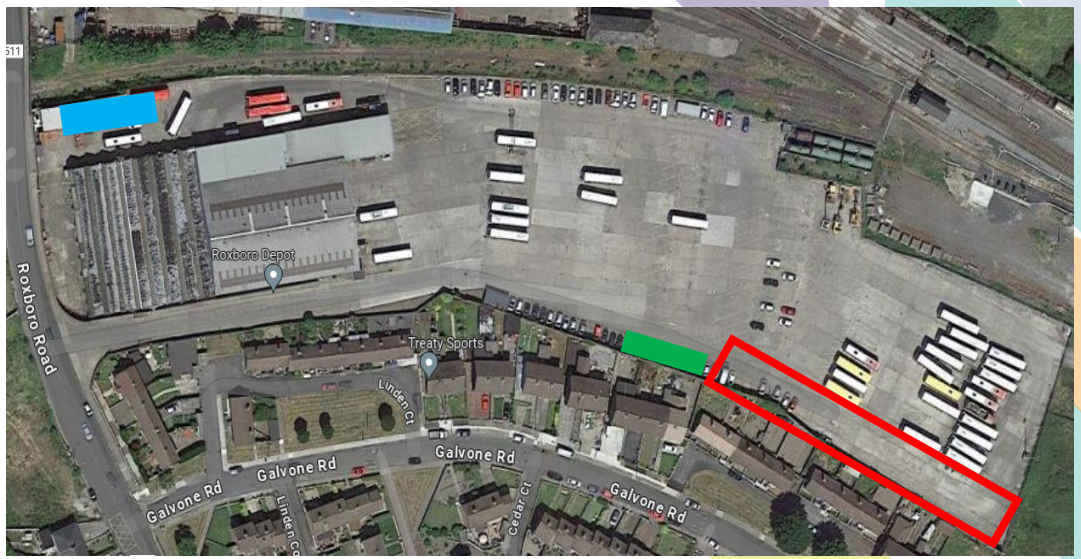
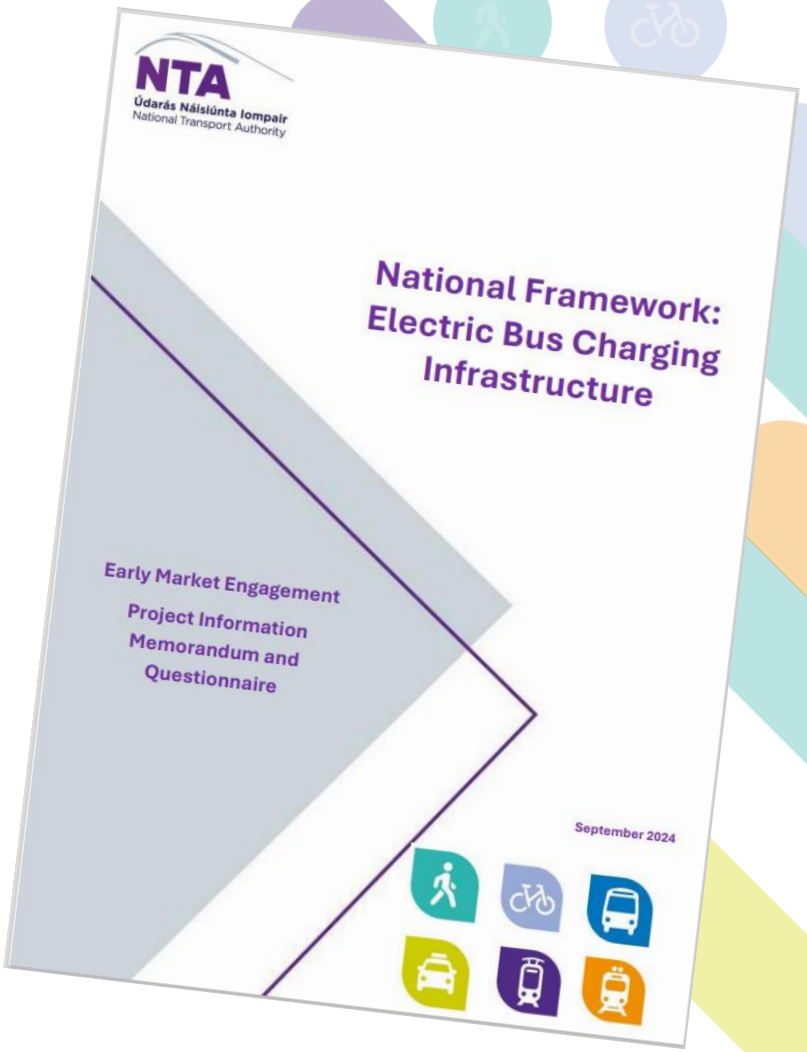
BÉ Depot Electrification - Limerick Roxboro Ph.2

- Works are ongoing at Roxboro Depot to provide a further 20 x charging pedestals each outfitted with 2 charging guns
- It is currently expected that this enhanced battery-electric bus charging infrastructure will be commissioned during Q1 2025
- Roxboro Depot will then be capable of supporting the charging of a minimum of 70 battery-electric buses



Electric Bus Charging Infrastructure Framework

- In order to expedite the provision of further high-power charging infrastructure primarily designed to support the operation of battery-electric buses, the NTA is proposing to commence a procurement competition for a multi-provider Framework Agreement for the supply of same, as well as associated services and works
- At a high level, the scope of the proposed Framework Agreement will include the design, supply, installation, testing, commissioning and maintenance and/or long-term support of such charging infrastructure, and associated customer side electrical distribution network upgrades
- An early market engagement exercise is underway to enable the NTA to discuss its intentions and assumptions with the market prior to commencing any procurement competition
- It is intended that the new Framework Agreement will be in place by Q3 2025



Non-Urban Public Bus Fleet Transition Strategy

- A strategy for the decarbonisation of non-urban public bus services is currently under development
- This is complicated by the fact that a significant proportion of these services are provided by M3 Class III vehicles (i.e. coaches) and there are currently very few viable zero-emission coaches being produced by vehicle manufacturers for right-hand drive (RHD) markets such as Ireland
- The NTA therefore undertook a market consultation during 2023 which received 8 responses and highlighted the following:
  - 6 respondents stated that they were developing at least one zero-emission M3 Class III coach product, all of which were single-deck, whereas 1 respondent stated that it could already supply zero-emission single-deck and double-deck coaches
  - 3 respondents were initially focusing on developing a zero-emission M3 Class III coach product with a fuel-cell-electric powertrain; 1 of these 3 indicated that a RHD version could be available from 2026 and 1 indicated from 2027; the other only indicated that a LHD version could be available from 2025
  - 3 of the 6 respondents were initially focusing on developing a zero-emission M3 Class III coach product with a battery-electric powertrain; 2 of these 3 indicated that a RHD version could be available from 2027; the other only indicated that a LHD version could be available from 2027