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BALINGUP RAIL GROUP
September 2026
The Global Evolution of Battery-Electric Passenger Rail 2021 – 2026
Supplement to the
Zero Emissions Tourist and Commuter
Railway Feasibility Study and Business Case
Bunbury to Bridgetown Western Australia
August 2024
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Foreword

The Balingup Rail Group's Zero Emissions Tourist and Commuter Railway Feasibility Study and Business Case established the case for recommissioning the South West railway corridor, with Stage 1 focused on Bunbury–Bridgetown.

The Cultural Tourism Supplement to the Feasibility Study then broadened that case by identifying the railway's potential as a high-yield tourism and cultural spine.

This updated Battery-Electric Rail Strategy adds a further dimension: it tests the original battery-electric proposition against the rapid international development of battery-powered passenger rail between 2021 and September 2026.

The developments now emerging are particularly relevant to Western Australia. France has just placed its first two battery-powered regional trains into commercial service, using converted existing regional railcars and batteries to operate on non-electrified sections.

CAF has demonstrated 273 km of battery-only operation in Germany. Hitachi Rail is bringing a new BEMU to InnoTrans 2026, while Siemens is supporting a 61-train German battery fleet through a long-term service model. Wellington is progressing an 18-train battery-electric regional programme.

These are not all identical technologies or operating models. Their importance is that they collectively demonstrate a rapidly widening range of practical solutions: conversion of existing vehicles, battery-only regional operation, operation across mixed electrified and non-electrified networks, terminal or opportunity charging, regenerative energy recovery and long-term manufacturer-supported fleet management.

For the South West Railway Western Australia , this strengthens—not replaces—the original Feasibility Study. It provides a stronger evidence base for assessing whether zero-emissions passenger and high-yield tourism services can be delivered without the capital burden of continuous overhead electrification. It also supports a staged approach in which charging infrastructure is concentrated at appropriate locations and future partial or full electrification remains possible if traffic growth eventually warrants it.

This report is intended to assist Ministers, government agencies, industry leaders and investment decision-makers in considering the South West Railway within the rapidly changing technology, transport, regional development and tourism environment of 2026.

The Hon Malcolm Lee KC
Chair, Balingup Rail Group
September 2026

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Document purpose

This revised edition prepared by Chair The Hon Malcolm Lee and BRG Executive Officer Gary Hodge incorporates the additional France and Hitachi developments supplied by the Chair, alongside the CAF, Siemens, Wellington, Australian and Western Australian policy evidence.

It is a strategic supplement to the BRG Feasibility Study and Cultural Tourism Supplement, not a replacement for detailed engineering or investment due diligence.

Executive Summary

Battery-electric passenger rail has undergone a marked transition between 2021 and September 2026—from demonstration and early trials to commercial regional services, fleet-scale procurement, long-term maintenance contracts and materially improved demonstrated range.

The original BRG Feasibility Study identified battery-electric traction as the preferred zero-emissions technology for Bunbury–Bridgetown, modelling four repurposed battery-electric railcars and high-capacity charging at Bunbury and Bridgetown. This report updates that proposition against the 2026 international market.

The most significant new evidence is the convergence of several developments. **C**AF has demonstrated 273 km of battery-only operation with a production-oriented Civity BEMU platform in Germany.

France has commenced commercial operation of its first two battery-powered TER regional trains, converted from existing AGC railcars, with more than 80 km of battery range and regenerative braking.

Hitachi Rail is showcasing a new BEMU with up to 100 km battery range, double-pantograph charging and regenerative braking, aimed specifically at routes without continuous electrification.

Siemens is supporting 61 Mireo Plus B trains through a long-term service arrangement. Wellington is progressing 18 BEMUs for regional services.

The strategic significance is not that every South West service would necessarily require a 100 km, 200 km or 273 km battery range.

Rather, the technology envelope has expanded and the available operating architectures have multiplied. This makes route-specific modelling more important than selecting a technology by headline range alone.

The economic proposition is equally important. Battery-electric trains can allow governments to decarbonise regional rail without automatically installing continuous overhead line equipment across an entire corridor. Electricity can instead be concentrated at selected charging locations, or used on electrified sections with battery operation beyond them.

At the Federal level, the Australian Government's Transport and Infrastructure Net Zero Roadmap explicitly identifies battery-electric rail trials and the development of charging infrastructure as part of the 2025–2030 pathway, with greater use of battery-electric and other zero-emission technologies anticipated thereafter. [11–12]

At the Western Australian level, the strategy aligns with the State's regional development, tourism diversification and international visitation objectives. The 2026 China mission is explicitly aimed at increasing visitation and supporting local jobs and businesses; Tourism WA identifies high-value Chinese travellers seeking nature, food and wine experiences. [13–14]

The conclusion is that the South West Railway should now be assessed using the 2026 battery-electric technology envelope and a whole-of-life infrastructure comparison. The evidence supports proceeding to investment-grade route energy modelling and procurement analysis, with battery-electric traction as the lead zero-emissions option for detailed assessment.

1. Purpose and Strategic Context

This supplement asks four questions:

How rapidly has battery-electric passenger rail developed between 2021 and September 2026?

What improvements have occurred in practical range, energy recovery, charging and fleet deployment?

What infrastructure and lifecycle costs may be avoided by not continuously electrifying a regional corridor?

How should these developments influence the proposed Stage 1 Bunbury–Bridgetown and future extensions?

2021–2023: from proof of range to passenger deployment

Stadler's FLIRT Akku demonstrated a 224 km battery-only range in 2021, providing an early proof point that battery-electric regional trains could travel well beyond short branch-line applications. Through 2022 and 2023, BEMU options increasingly entered fleet planning and passenger-service programmes.

The strategic change was the emergence of a third pathway between diesel operation and full route electrification: battery trains could use existing electrified infrastructure where available and store energy for non-electrified sections.

2024: commercialisation and improved energy density

By 2024, Siemens Mireo Plus B units were operating commercially in Germany. Hitachi also reported next-generation battery development aimed at reducing battery size while increasing energy density. These developments reinforced the relevance of both new-build BEMUs and conversion or repurposing of suitable existing railcars.

The South West implication is that the original BRG conversion concept should remain an option, but not an assumption. Current procurement should compare conversion, new-build and hybrid architectures against actual route energy demand.

Evidence note: *The 2021–2024 chronology retains the earlier report's evidence and interpretation; new developments are separately identified in the following section.*

2. 2025–September 2026: Commercial Maturity Accelerates

France: regional battery trains enter service

On 31 August 2026, Occitanie's first battery-powered regional train entered commercial service on the Nîmes–Vauvert line. A second train had already entered service in the Sud region on the Avignon–Carpentras line. The programme involves five French regions, SNCF Voyageurs and Alstom and is valued at €41 million. The trains were converted from existing AGC railcars, replacing diesel engines with lithium-ion batteries and achieving more than 80 km of range. Regenerative braking can reduce energy consumption by up to 20%.

This is directly relevant to Western Australia because it demonstrates a regional operating model in which battery power is used on non-electrified sections without extending catenary across those sections. The Sud service, for example, runs electrically under existing overhead wires before switching to battery power for the non-electrified section to Carpentras.

CAF: 273 km battery-only test

CAF's Civity BEMU completed 273 km solely on battery power at the Siemens test centre in Wildenrath in Germany. The test used standard production lithium-titanate-oxide traction batteries and evaluated traction, energy management and battery behaviour under demanding conditions

Hitachi: a significant new BEMU development

Hitachi Rail's 2026 InnoTrans programme introduces a new BEMU with up to 100 km battery range, double-pantograph charging, regenerative braking and underframe batteries. Hitachi states that the train is intended to eliminate diesel on routes without continuous electrification and could reduce CO_2 emissions by up to 70% compared with existing diesel trains. These are manufacturer claims that should be validated independently before use in a Western Australian business case.

3. 2026: Fleet Scale, Lifecycle Models and Australasian Evidence

Siemens: battery rail as a long-term asset model

Siemens Mobility's long-term service model for 61 Mireo Plus B battery-electric trains in North Westphalia is strategically important because it shows that BEMU procurement is being integrated with long-duration maintenance, availability and asset-management arrangements rather than being treated solely as a technology trial.

For Western Australia, this broadens the procurement discussion. The future South West Railway could be evaluated through conventional purchase as well as leasing, availability, manufacturer-supported maintenance or other lifecycle models, subject to public procurement requirements.

Wellington: an Australasian regional precedent

New Zealand's Wellington regional programme is particularly relevant because it demonstrates that battery-electric trains are being considered in a nearby Australasian setting for regional services. The model combines existing electrified sections with battery operation beyond the electrified network.

What has changed since the original Feasibility Study?

- Demonstrated battery-only range has increased substantially.
- Conversion of existing regional railcars is now a live commercial model in France.
- Battery charging can be integrated with existing electrified infrastructure or concentrated at selected locations.
- Regenerative braking is being incorporated into production and converted fleets.
- Fleet-scale procurement and long-term maintenance models are developing.
- Battery-electric technology is being considered for regional services in Australasia as well as Europe.

The appropriate conclusion is not that battery trains are now universally superior. It is that the technology has matured sufficiently that a 2026 route-specific BEMU study is warranted and should replace assumptions based on earlier-generation technology.

Evidence note: *France: Alstom/SNCF; CAF; Hitachi; Siemens and Wellington evidence. See full source list on page 13.*

3. Economics of Battery-Electric Regional Rail

The economic comparison should be made on a whole-of-life basis. For a regional corridor, the relevant question is not simply whether overhead electrification is technically capable of delivering electric traction. It is whether the traffic intensity and service pattern justify the fixed infrastructure required:

- Potential overhead-electrification cost categories
- overhead masts, contact wire and support systems;
- substations and high-voltage connections;
- clearance and bridge modifications;
- civil works and corridor interventions;
- specialised inspection and maintenance; and
- construction expenditure incurred before the full passenger benefit is realised.

Battery-electric operation changes the infrastructure architecture.

Instead of providing continuous electrical supply along the route, charging can be concentrated at termini, depots or selected intermediate points. Where existing electrification is available, the train can use that electricity directly and reserve battery power for non-electrified sections.

The Great Western Railway fast-charge battery work cited in the original report is important because it compared diesel, conventional overhead electrification and fast-charge battery operation through a whole-of-life ownership lens. The evidence should be treated as a comparator rather than transferred directly to Western Australia.

The South West test

For Bunbury–Bridgetown, the updated business case should model rolling stock, charging infrastructure, electricity supply, battery replacement, maintenance, residual value, track rehabilitation, reliability, construction risk and future extensions. The comparison should include diesel, battery-electric, hydrogen and continuous or partial electrification.

The key strategic advantage of BEMU is therefore optionality: zero-emissions passenger services can potentially commence without making continuous overhead electrification a precondition.

Evidence note: *International cost evidence supports the analytical approach; Western Australian costs require route-specific engineering and grid assessment.*

4. International Case Studies and Relevance to Western Australia

Case	2026 evidence	Strategic significance	South West relevance
France / Alstom-SNCF	Converted AGC; >80 km; commercial TER service	Existing railcars can be converted for non-electrified regional operation	Highly relevant to BRG's original conversion concept
Germany / CAF	273 km battery-only test	Large practical range envelope demonstrated	Supports testing longer South West duty cycles
Hitachi Rail	New BEMU; up to 100 km; double-pantograph charging	Scalable battery regional platform	Relevant benchmark for procurement and charging
Germany / Siemens	61 Mireo Plus B with long-term service	Lifecycle/availability model maturing	Supports alternative procurement structures
New Zealand / Wellington	18 BEMUs for regional services	Australasian regional precedent	Closer geographic comparator for WA

Across these cases, the consistent development is not one single battery specification. It is the emergence of a flexible operating architecture: battery trains can bridge unelectrified sections, reduce diesel use, use existing electrical infrastructure where available, and avoid the need to electrify every kilometre of a regional route.

This is particularly relevant to the South West because the project is proposed as a staged regional railway rather than a high-frequency metropolitan corridor. The investment question can therefore focus on the least-cost combination of rolling stock, charging and corridor rehabilitation that delivers the required passenger and tourism service.

Evidence note: *Case-study evidence: Alstom/SNCF France; CAF; Hitachi Rail; Siemens; Wellington. Claims and ranges should be independently validated in procurement.*

5. Implications for Stage 1: Bunbury–Bridgetown

The original BRG operating concept between Bunbury and Bridgetown is increasingly compatible with the international direction of battery-electric regional rail:

- Defined regional corridor with known termini.
- Moderate proposed service frequency rather than metropolitan headways.
- Turnaround periods that can potentially accommodate charging.
- Combined passenger, commuter and high-yield tourism demand.
- Potential to adjust capacity for events and peak tourism services.Existing corridor in which capital can be directed first to recommissioning, safety, stations and passenger facilities.

The charging proposition

The Feasibility Study identified Bunbury and Bridgetown as high-capacity charging locations. The new evidence justifies revisiting the sizing and configuration of that infrastructure rather than abandoning the concept.

The 2026 engineering study should test terminal-only charging, terminal charging plus resilience charging, opportunity charging, partial electrification and mixed architectures. The CAF 273 km test means that range assumptions should be based on actual duty-cycle modelling rather than older generic battery ranges.

Recommended technical work

- Route survey and detailed energy simulation.
- Battery duty-cycle modelling under worst-case climate and passenger-load conditions.
- Charging-power and grid-capacity assessment at Bunbury and Bridgetown.
- Comparison of new-build BEMU, converted EMU/railcar and other suitable platforms.
- Whole-of-life comparison against diesel, hydrogen and overhead electrification.
- Independent battery replacement, maintenance and residual-value assessment.

Future-proofing for Pemberton and Manjimup.

This would convert the current advocacy proposition into an investment-grade technical comparison while preserving the central strategic advantage: zero-emissions regional passenger services need not wait for continuous electrification.

6. Future Extensions and High-Yield Tourism

The South West Railway should be planned as a staged transport and tourism spine, not solely as a Bunbury–Bridgetown commuter route.

Pemberton and Manjimup

Improving battery performance creates greater flexibility for future extensions. It does not mean that every extension will automatically operate on a single charge: gradients, speed, stops, climate, HVAC load, passenger loading and charging time must determine the final architecture.

The planning model can nevertheless now consider combinations of terminal charging, intermediate charging, selective electrification and future battery upgrades rather than treating diesel or full corridor electrification as the only practical alternatives.

High-yield tourism

The Western Australian Government's 2026 China mission is explicitly aimed at strengthening aviation connectivity, increasing inbound visitation and building tourism partnerships. China remains WA's largest international visitor market by spend. Tourism WA also states that its China strategy targets High Value Travellers who seek nature, food and wine experiences. [13–14]

This Supplement provides a strong strategic context for the Cultural Tourism Supplement. A scenic South West railway can connect visitors with food and wine, forests, heritage, towns, events and accommodation while reducing the need for visitors to self-drive the entire itinerary.

The opportunity is therefore to develop rail as an experience platform supporting international, national and local packaged itineraries, overnight stays, regional dispersal and locally delivered cultural tourism products.

Links to the Busselton-Margaret River Airport are particularly relevant when viewed as part of an integrated transportation strategy

Policy alignment

Federal transport policy identifies investment in enabling low- and zero-emissions infrastructure, electrification where appropriate, low-carbon alternatives where electrification is not feasible, and innovation to expand cost-competitive transport technologies. The Federal Net Zero Roadmap specifically identifies battery-electric rail trials and charging infrastructure as part of the 2025–2030 pathway. [11–12]

The ARA's 2026 Future of Rail research similarly identifies lifecycle performance, resilience, net zero, sovereign capability, innovation and regional employment as interconnected rail policy outcomes.

7. Strategic Recommendations

1. Update the traction technology case — Use current 2026 BEMU performance, range, charging and lifecycle data.

2. Commission route-specific energy modelling — Model the South West route using actual gradients, speeds, stops, climate, passenger loads and auxiliary energy.

3. Compare whole-of-life infrastructure — Assess battery-electric, diesel, hydrogen, partial electrification and continuous electrification on lifecycle cost and risk.

4. Retain Bunbury and Bridgetown charging as the base case — Re-test the original charging concept using 2026 battery and charging performance.

5. Investigate conversion as well as new-build — France demonstrates that conversion of existing regional railcars is now a live commercial pathway.

6. Investigate lifecycle procurement — Consider purchase, lease, availability and manufacturer-supported models.

7. Preserve future electrification optionality — Do not foreclose partial or full electrification if future demand justifies it.

8. Integrate transport and tourism investment — Treat high-yield tourism as a core market, not a secondary benefit.

9. Align advocacy with government policy — Position the project within net zero, regional connectivity, infrastructure resilience, innovation and tourism diversification.

10. Establish an evidence-led next step — Move from technology advocacy to an independently validated investment-grade engineering and economic assessment.

The evidence does not support assuming that every regional railway should use batteries. It does support a clear conclusion for the South West planning process: battery-electric traction has matured sufficiently that it should be the lead zero-emissions technology assessed in detail for Stage 1, alongside credible alternatives.

8. Conclusion and Evidence Base

Between 2021 and September 2026, battery-electric passenger rail has moved from promising demonstration to a diverse set of commercial and near-commercial regional operating models.

France provides a particularly relevant example for Western Australia: existing regional railcars have been converted to battery operation and placed into commercial service on regional lines with non-electrified sections. CAF has demonstrated 273 km of battery-only operation. Hitachi is introducing a new BEMU platform with a 100 km stated range and regenerative braking. Siemens is demonstrating long-term fleet support at scale. Wellington provides an Australasian regional precedent.

The cumulative evidence strengthens the original BRG proposition. The South West Railway does not necessarily need continuous overhead electrification to provide zero-emissions passenger services. Instead, charging and battery capacity can be matched to the actual duty cycle, with future electrification retained as an option where demand and economics warrant it.

The next step should therefore be a route-specific, independently validated technical and economic assessment using the 2026 technology envelope. That assessment should determine the optimum combination of rolling stock, charging, battery capacity and infrastructure for Bunbury–Bridgetown and establish a scalable pathway towards Pemberton and Manjimup.

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Prepared by Malcolm Lee and Gary Hodge for Balingup Rail Group. This strategic supplement is evidence-based but does not substitute for detailed engineering, safety, environmental, procurement or financial due diligence.

Balingup Rail Group (Balingup Progress Association)

PO Box 89 Balingup WA 6260

Email balinguprailgroup@outlook.com

Website https://www.balingup.asn.au/Balingup_Rail_Group/introduction.html

Contact: Executive Officer Gary Hodge 0417 985 897