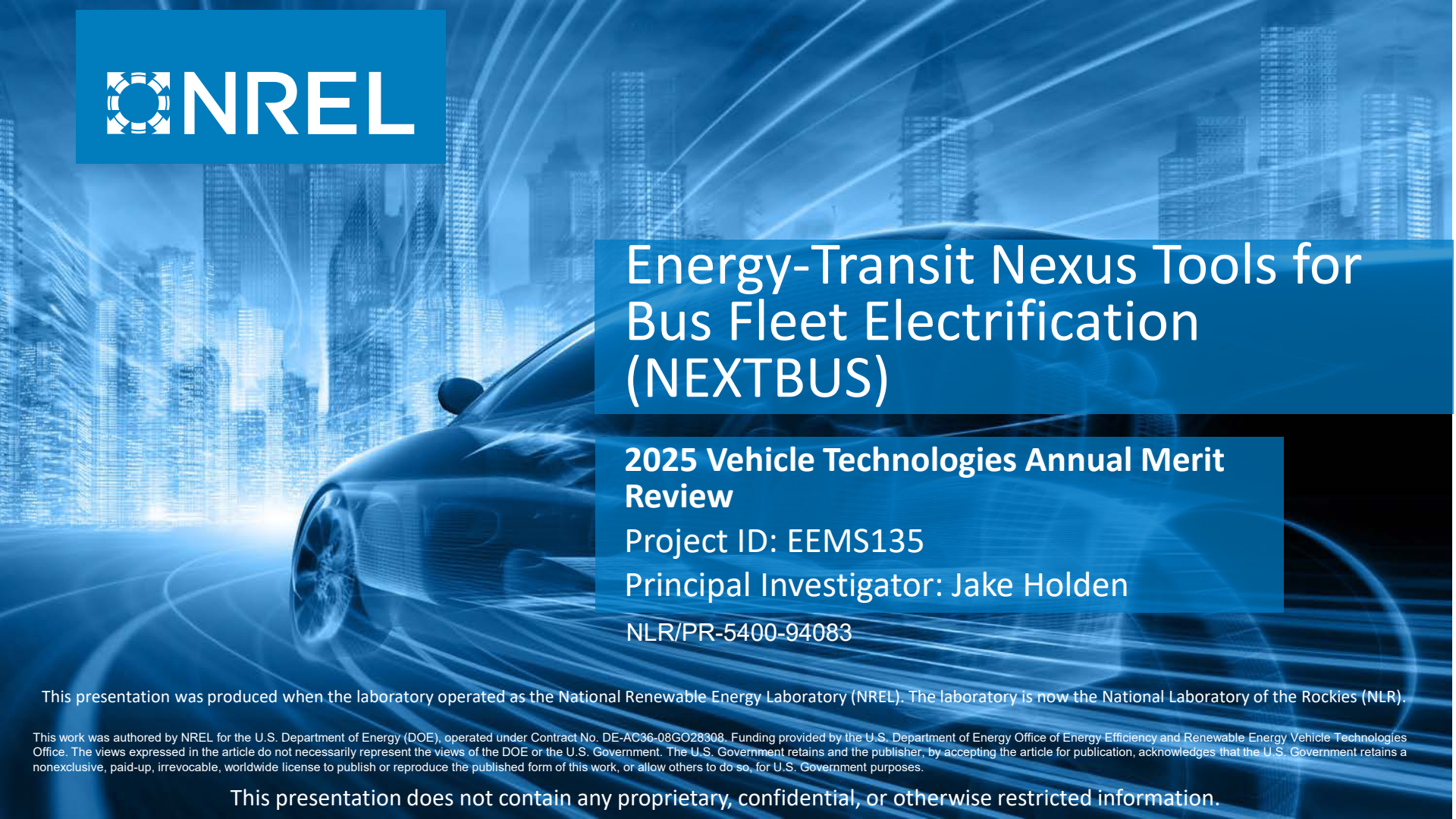


Energy-Transit Nexus Tools for Bus Fleet Electrification (NEXTBUS)

2025 Vehicle Technologies Annual Merit Review

Project ID: EEMS135

Principal Investigator: Jake Holden

NLR/PR-5400-94083

This presentation was produced when the laboratory operated as the National Renewable Energy Laboratory (NREL). The laboratory is now the National Laboratory of the Rockies (NLR).

This work was authored by NREL for the U.S. Department of Energy (DOE), operated under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Vehicle Technologies Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

This presentation does not contain any proprietary, confidential, or otherwise restricted information.

Overview

Timeline

- Project start date: 1/1/25
- Project end date: 12/31/27
- 14% complete

Budget

- Total project funding: $1.3M
  - DOE share: $1.18M
  - Contractor share: $150k
- Funding for FY 2025: $332k
- Funding for FY 2026: $443k

Barriers Addressed

- Mesoscopic system modeling capabilities for future mobility scenarios
- Enable new mobility technology deployment with new open-source tools

Partners

- OEMs, transit agencies, and Clean Cities & Communities Coalitions are engaged stakeholders
- Commercialization partner: ReVolt Battery Technology

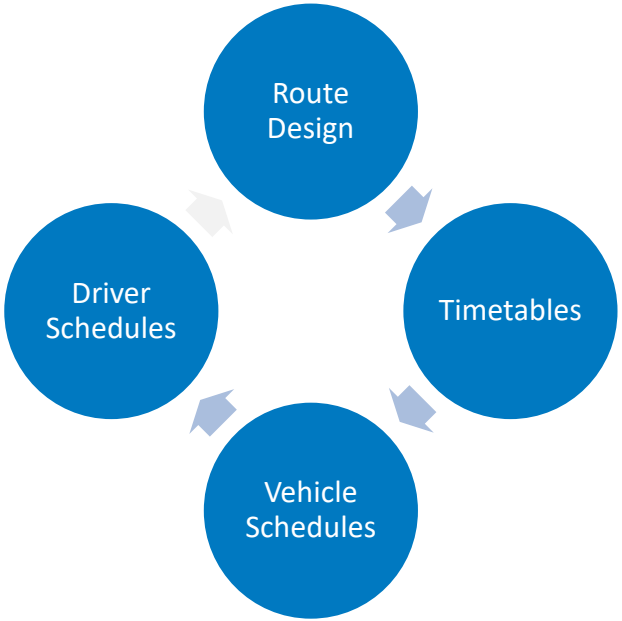
Project Objectives & Relevance

- Enable better operation of complex mixed bus transit fleets and increase levels of service through better planning and decision support tools and ridership to further improve energy efficiency of public transportation.
- Reduce barriers to adoption of battery electric transit buses through integration of NREL vehicle energy modeling and optimization capabilities with commercial fleet services software.
- Provide high fidelity, accessible, transparent, and easy to use planning and operations tools to the broader public transit community.

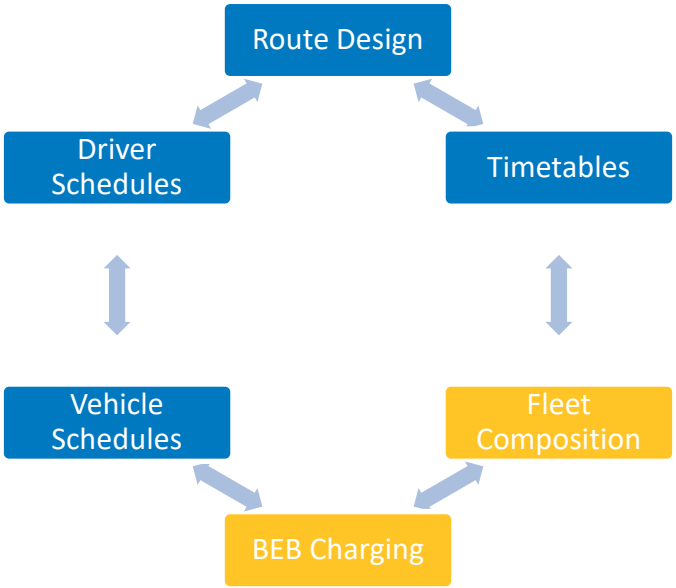
- Prioritizing open-source software development increases the likelihood of successful technology deployment and real-world benefits.
- Mixed fleet operations optimization technology has applications across light-, medium-, and heavy-duty passenger and freight modes.

Approach Summary

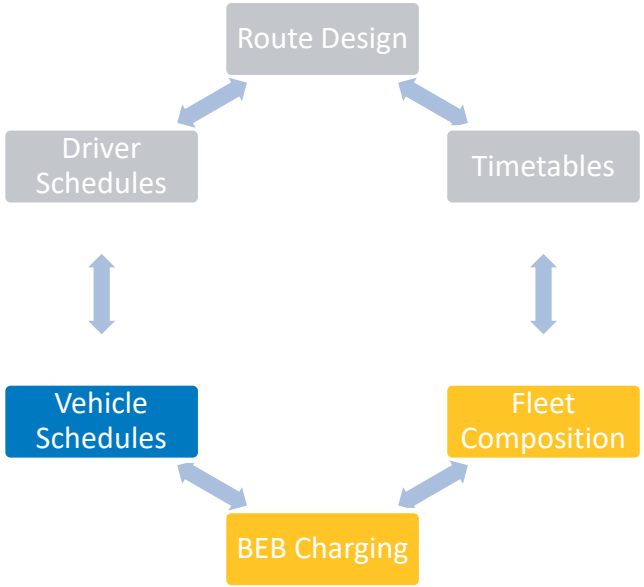
Traditional Approach



Added BEB Complexity



Approach: NEXTBUS Priorities



Fleet Composition
- BEB specs & quantities

BEB Charging
- EVSE sizing & siting
- Charge management

Vehicle Schedules
- Charge schedules
- Delay and uncertainty
- Blocking

Approach: NEXTBUS Integration

NEXTBUS

Vehicle modeling

Network optimization

- Open-source software built on NREL's vehicle energy modeling (FASTSim & RouteE) and network/fleet operations optimization technologies
- Modular software with a robust API that allows for flexible integration into consumer-facing software
- Reliant on static and dynamic data sources from such as FleetDNA telematics, bus energy models, and GTFS data
- **Output:** vehicle schedules (including charging plans) based on fixed route and timetable constraints

ReVolt

- Commercial product
- Serves vehicle and driver schedules based on NEXTBUS outputs
- Manages dynamic NEXTBUS inputs

- ReVolt will rely on NEXTBUS as the computation engine to determine optimal vehicle schedules based on input GTFS data, which fixes route and timetable requirements
- The end-user (e.g., transit fleet manager) will be able to seamlessly integrate vehicle schedules for a more complex mixed fleet of electric and conventional buses into their typical workflow

Technical Accomplishments & Progress

Description	Due	Status
Engage with representatives of at least 3 Clean Cities and Communities Coalitions and 1 labor union to collect priority concerns and identify opportunities for positive impact with initial deployments.	3/31/25	Complete
Review both NREL's energy modeling and bus fleet operation technologies and ReVolt's current and planned bus fleet SaaS development map. This task will identify data gaps and technical refinement needs for the integration of NREL's technologies into ReVolt's bus fleet SaaS product development roadmap.	6/30/25	On track
Identify, prioritize, and begin work on refinements necessary to make NREL tools production ready and create and NREL technology development roadmap.	6/30/25	On track
Initial release of NREL software suitable for integration testing.	12/31/25	On track
Evaluate market potential, competitive advantages, and develop a strategy to effectively communicate the benefits of the fleet services product to customers. This will primarily include a review of previous technoeconomic analyses and augmentation where necessary to estimate the energy efficiency and economic impacts from optimized battery electric bus operation in transit fleets.	12/31/25	On track

Collaboration & Coordination

- Transit agency and fleet manager engagement to collect feedback on key operational challenges for operating electric buses and current solutions
- OEMs are engaged to ensure new bus capabilities, configurability, and charging requirements are accurately represented in NEXTBUS

- NREL and ReVolt work collaboratively to prioritize key features in NEXTBUS for the development roadmap
- ReVolt maintains a clear vision for addressing operational challenges that transit fleets face and can ensure maximum impact for NEXTBUS

Challenges → Proposed Future Research

- Further testing of the NEXTBUS value proposition in the transit customer segment and identifying synergies with non-transit customer segments (e.g., freight) is necessary → Work with ReVolt and potential end-users to identify opportunities to generalize the software.
- Robust APIs and modular software components to facilitate flexible integration across platforms → Release a minimum viable product (MVP), suitable for integration testing by ReVolt, by the end of 2025.
- Validate the accuracy and effectiveness of NEXTBUS in real-world transit environments → conduct pilot deployments with ReVolt and partner transit agencies to gather feedback and prioritize software refinement.

Any proposed future work is subject to change based on funding levels.

Summary

- **Collaborative Roadmap Developed:** Established a detailed development roadmap in partnership with ReVolt, outlining key milestones and deliverables.
- **Stakeholder Feedback Gathered:** Compiled valuable initial feedback from transit agencies, Clean Cities and Communities Coalitions, and transit labor representatives to ensure user-centered development.
- **Modular Software Development Initiated:** Began initial development of the NEXTBUS tool, focusing on modularizing bus energy modeling and network optimization capabilities for flexible integration.
- **Value Proposition Testing and Generalization** (In Progress)**:** Working with ReVolt and potential end-users to test the NEXTBUS value proposition and identify opportunities to generalize the software for non-transit customer segments (e.g., freight).
- **MVP Release for Integration Testing** (In Progress)**:** Aiming to release a minimum viable product (MVP), suitable for integration testing by ReVolt, by the end of 2025, with robust APIs and modular software components.

Any proposed future work is subject to change based on funding levels.