Abstract ID 404

GERMAN-CUBAN COLLABORATION: DEVELOPING A RETROFIT CONCEPT TO TRANSFORM HAVANA'S SUBURBAN DIESEL RAILCARS INTO BATTERY-POWERED TRAINS

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Keywords: battery train, BEMU, decarbonisation, vehicle concept, simulation, recharging infrastructure, Havana

Summary: The operation of battery electric trains in Germany and Cuba has a history of over 100 years. Driven by the global climate movement, this technology is experiencing a renaissance, with innovations leading to modern hybrid vehicles known as Battery Electric Multiple Units (BEMUs). These vehicles combine traditional electric traction with onboard energy storage, making them a viable solution for decarbonizing non-electrified rail lines. Technische Universität Berlin (TU Berlin) has provided scientific support for several BEMU-related projects across various stages of development during the recent years. This includes assistance with the development, introduction, and passenger operation of a demonstrator BEMU, which was derived from a conventional electric trainset family. Additionally, TU Berlin has supported transport authorities in transitioning diesel-based rail systems to electric alternatives through feasibility studies and operational strategies. In Cuba, public transport infrastructure around Havana faces significant challenges, including outdated technology and declining passenger numbers. To address these issues, the Ministry of Energy and Mines (MINEM) has proposed the introduction of electric rail vehicles as part of a broader modernization strategy. As part of this initiative, the technical and economic feasibility of introducing electric rail transport will be examined. A related project by the Centro Investigación y Manejo Ambiental del Transporte (CIMAB) focuses on the modification of current CB-10 diesel multiple units (DMU) to battery trains (BEMU) for suburban services in Havana.The project will benefit from the findings of current BEMU projects through cooperation between CIMAB and TU Berlin: The analysis of modern BEMU structures aims to identify general requirements and suitable components for Cuban suburban operations. The goal is to develop a basic vehicle conversion concept for existing CB-10 vehicles that is preferably uncomplicated and ensures robust operation under the local conditions. Vehicle dynamics simulations with energetic considerations have been carried out for each line of the Havana suburban network for dimensioning of the battery system. A key focus is the energy flows structure of the vehicle's powertrain. The project identifies a suitable recharging interface that considers both these requirements and the local infrastructural constraints. Discussing the results, vehicle parameters are derived which can be used in the further process of a prototype retrofit. Additionally, there are unique conditions for electrical energy supply in Cuba: due to recurring blackouts, supply stability cannot be assumed. Outdated or inefficient power plants further complicate the situation, generating an unusually high carbon footprint when generating electricity. To address these challenges, a recharging infrastructure concept is being developed for the Havana suburban railway network. This approach focuses on reducing transportation emissions by integrating locally generated renewable energy sources while ensuring a stable and reliable energy supply.