



Projet SETP 2050 : Descriptif succinct (Deutsche / English summary)

P-249 PVxTutt'Elettrico - Massimizzazione dell'efficienza e dell'efficacia nel passaggio dalla trazione diesel alla trazione elettrica grazie al fotovoltaico fisso e mobile

Champ d'activité / Type de projet	[Bus, ESPT2050, Vehicles] [Applied research and development]	Durée prévue du projet	[01.04.2022- 30.09.2023]
Mandataire / direction du projet	SUPSI Vasco Medici, vasco.medici@supsi.ch	Budget total / Contribution OFT	154000 CHF / 61600 CHF

Objectives

- Prepare a practical-operational guide to defining the transition strategy for the electrification of urban bus lines, tested on the cases of AMSA and FART and replicable in other contexts, aimed at reducing economic losses from potential disinvestment from diesel bus fleets and optimizing self-consumption of electricity from renewable photovoltaic sources;
- Perform an analysis of the feasibility of a new electric bus fleet for AMSA and FART city lines and the development of a tool for analyzing the feasibility of electrifying a generic line;
- Perform an analysis of the impacts on the electricity grid based on charging power peak reduction and self-consumption from photovoltaic systems.

Method

1. Feasibility analysis :

- Formulate the mathematical problem as an extended version of the vehicle routing problem,
- Set strict feasibility constraints based on the existing trip time tables and bus schedules,
- Solve the problem using a standard solver that supports mixed integer non-linear problem.

2. Economic analysis :

- Expand the model mentioned earlier to include economic and renewable power constraints.
- Relax the strict feasibility constraints in part (1) to enable the solver to search over a wider solution space,
- Reduce problem dimensionality (where possible and reasonable) to improve the solution time.

3. Grid impact analysis:

- Extract charging power for each charging time-step that results from solving the optimization problem,
- Estimate the potential transformer overloading at the MV bus bar.

Expected results

1. Feasibility analysis :

- For a given line (FART or AMSA), whether or not there is a feasible one-to-one replacement option for diesel buses with electric buses,
- Given there exists a feasible option, the minimum battery size required such conversion,
- An assessment on the suitable charging strategy, e. g., opportunity charging, overnight charging, etc.

2. Economic analysis :

- Optimal configuration of the bus fleet, e. g., minimum number of buses, battery sizes, etc.
- Trade-offs related to battery size and mixed bus fleets,
- Benefits of PV integration at the charging station.

3. Grid impact analysis :



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- Worst case transformer overloading at the MV bus bar,
 - Tradeoffs related to peak power management, e. g., demand charge savings and how charging power constraints might impact charging schedules, on-time dispatch of buses, etc.
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Deutsche Zusammenfassung

Das Hauptziel des Projekts PVxTutt'Elettrico ist es, den öffentlichen Verkehrsbetrieben einen praktischen Leitfaden zur Verfügung zu stellen, der ihnen hilft, eine Übergangsstrategie für die Elektrifizierung der städtischen Buslinien zu definieren. Bei der Ausarbeitung des Leitfadens werden FART (Ferrovie Autolinee Regionali Ticinesi) und AMSA (Autolinea Mendrisiense SA), die in den Regionen Locarno und Mendrisio-Chiasso tätig sind, als Fallstudien herangezogen. In Phase 1 des Projekts wird die Machbarkeit der Umstellung auf eine neue Elektrobusflotte für jede von FART und AMSA betriebene Stadtlinie analysiert. Anschließend integrieren wir das Analysemodell in eine webbasierte Plattform, die interessierten Verkehrsunternehmen kostenlos zur Verfügung gestellt wird, um eine schnelle Einschätzung der Machbarkeit der Umstellung ihrer Busflotte zu erstellen. Das Projekt konzentriert sich auch auf die wirtschaftliche Optimierung und die Analyse der Auswirkungen auf das Stromnetz, wobei das Ziel darin besteht, die optimale Konfiguration der Busflotte und die damit verbundenen Kompromisse unter Berücksichtigung der erneuerbaren Energien und der wirtschaftlichen Kosten zu finden.

English summary

The main objective of the PVxTutt'Elettrico project is to provide public transport companies with a practical-operational guide to help them define a transition strategy for the electrification of urban bus lines. In developing the guide, FART (Ferrovie Autolinee Regionali Ticinesi) and AMSA (Autolinea Mendrisiense SA), which offer services in the Locarno and Mendrisio-Chiasso regions, will be used as case studies. In phase 1 of the project, we analyze the feasibility of transitioning to a new electric bus fleet for each city line operated by FART and AMSA. Subsequently, we integrate the analytical model into a web-based platform that is available freely for interested transportation companies to get a quick assessment regarding the feasibility of converting their bus fleet. The project also focuses on economic optimization and grid impact analysis where the aim is to find the optimal configuration of the bus fleet and associated trade-offs considering renewable energy and economic cost considerations.