

# Impact Case Study

## Energy Transitions in the Transport Sector

### Introduction



Rising fuel prices, the impact of fossil fuel emissions on air quality and climate change, and the need to reduce reliance on overseas oil markets are all factors in the move to embrace renewable energy sources for our modes of transport.

Australia lags behind in the adoption of electric vehicles (EVs) both for private and public transport, attributable to a number of factors, including economic viability, inadequate investment in charging infrastructure, absence of efficient vehicle emissions standards, and a significant lack of EV support policies over the past decade.

### Background

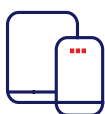


A key aspect of transport sector decarbonisation includes public transport electrification. Battery Electric Vehicle (BEV) buses can play a critical role in the energy transition. However, research

is required to find the best policies and tariff settings to optimise operational costs, power grid stability and reliability, wholesale market pricing, network congestion, and emissions reduction potential.

“Policy advice and a roadmap for Victoria have been created to help government, industry and the market to better understand the full cost and benefit implications of public transport electrification.

### The Research



Dr Zsuzsanna Cserekyei specialises in the economics of energy transitions, electricity markets and the adoption of efficient technologies. With industry consultation, Dr Cserekyei and her collaborators prepared two reports for RACE for 2030, a Cooperative Research Center (CRC) project, and several papers for a Victorian Higher Education State Investment Fund (VHESIF) project.

### The RACE for 2030 CRC Reports

- My V2X EV: Informing strategic electric vehicle integration – Final Report (April 2023)

This report examined the barriers to implementing bi-directional charging for EVs, supporting both households and the grid when required, with vehicle-to-everything (V2X) technology.

- N3 Opportunity Assessment Local Distributed Energy Resource Network Solutions – Final Report (July 2023)

Local Distributed Energy Resource Networks are small-scale solutions (e.g. solar powered microgrids and community batteries) that use, generate or store electricity to help local homes and businesses manage their energy demands. As well as using renewable energy resources, excess microgrid energy is often sold back to the grid.

This report aimed to discover the knowledge gaps in field. These included assessments of regulatory frameworks, trials to understand EV charging behaviours, energy storage feasibility studies, and assessment of cybersecurity vulnerabilities, among many other ideas.

### The VHESIF studies

Parallel to the RACE for 2030 reports, the team undertook three inter-related studies on the economics of public transport electrification as part of a VHESIF grant.

- The economics of public transport electrification: A case study from Victoria, Australia (April 2023)

This research investigated the economic, climate and electricity market implications of public bus fleet electrification based on the Melbourne Metropolitan region. The paper used a novel fleet-level analysis, under tariff-based least-cost depot charging to compare the total cost of ownership (TCO) over 12 years of battery electric vehicle (BEV) against diesel bus fleets in a transitioning power sector, and investigated the impacts on electricity demand and carbon emissions, across purchase years between 2022 and 2039.



- The economics of public transport electrification: The charging dilemma

This study built on the first, in analysing potential fleet-charging strategies. An open-source, BEV bus fleet charging optimisation model was used to minimise either the final electricity costs (tariff), wholesale prices (spot), or indirect greenhouse gas emissions (mitigation) related to fleet operations, and examined the impact of optimising one of these over the other two on fleet-related emissions and operational cost.

- The economics of public transport electrification: When does infrastructure investment matter?

The third paper examined the charging and network infrastructure required for a fully electrified metropolitan Melbourne bus network, using overnight depot charging. This included analyses of minimum and maximum fleet charging capacities, and the infrastructure augmented total cost of ownership.

## Project Outcomes



### RACE for 2030

My V2X EV: Informing strategic electric vehicle integration – Final Report

- [https://racefor2030.com.au/wp-content/uploads/2023/07/V2X-Stage\\_1\\_Final-Report.pdf](https://racefor2030.com.au/wp-content/uploads/2023/07/V2X-Stage_1_Final-Report.pdf)

N3 Opportunity Assessment Local Distributed Energy Resource Network Solutions – Final Report

- [https://racefor2030.com.au/wp-content/uploads/2023/08/N3OA-Final-Report\\_-1-1.pdf](https://racefor2030.com.au/wp-content/uploads/2023/08/N3OA-Final-Report_-1-1.pdf)

## The VHESIF studies

The studies found that while the upfront costs of BEV bus fleets are considerably higher than diesel, they are more economical to operate in the long run, although the calculations are sensitive to diesel price assumptions. Charging fleet vehicles at different time intervals during the day resulted in marked variation in final electricity cost and emissions, due to factors such as peak and off-peak pricing, and the intraday emissions associated with electricity generation. Suggested reforms include:

- co-optimising power and transport sector transitions by ensuring greater pass through of wholesale market pricing signals.
- restructuring large-customer tariffs, in particular peak/off-peak hours, allowing the hours around midday to be off-peak, to encourage daytime charging, thus increasing system stability and reducing emissions.
- streamlining the network augmentation process required to reduce uncertainty and project delays in implementing transport electrification.

Download “Economics of public transport electrification: A case study from Victoria, Australia”:

- <https://www.sciencedirect.com/science/article/abs/pii/S014098832300097X?via%3Dihub>

The other studies examining “the charging dilemma” and “infrastructure investment requirements” are currently being reviewed for publication.

## Overview of the Impact

### Policy Advice



The three studies include policy advice and a roadmap for Victoria, to help stakeholders to better understand the full implications of public transport electrification and further explore EV policy, strategy and regulation.

### Open Source code

The open-source codes used to analyse information for these studies have been provided freely to other researchers. This tool can be used to evaluate public transport electrification in other jurisdictions, different pathways to transition, and can provide the basis for analysing the health benefits/healthcare cost reductions from lower vehicle emissions.

### Presentations

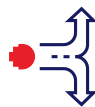
Dr Csereklyei has been invited to present on Australia’s energy transition, energy policy dilemmas and solutions by several organisations, including the Victoria State Government (DEECA), the CEO Institute, and the Economic Society of Australia. She has also organised RMIT’s Energy Industry Lunches, bringing professionals from academia, industry and government together with speakers from all sectors.

## Funding Support and/or Institutional Support



The projects were funded by CRC’s RACE for 2030 (<https://racefor2030.com.au>) program and VHESIF’s “Supporting the Electrification of Victoria’s Future Fleet” project.

## Next Steps



Several articles based on these studies and reports are under review and are expected to be published in 2023-2024.

Dr Csereklyei is also applying for further funding to extend her research into how private transport electrification interacts with the decarbonisation of the electricity generation system. She continues to engage with industry and government.

It is expected that further societal and government impacts will be realised from this research in years to come.

