

Advancing Transportation Efficiency and Electric Vehicles in Tonga:

A Review of Relevant Trends, Best Practices, and Future Work

Prateek Joshi, Bonnie Powell, Dustin Weigl, Caley
Johnson, Derina Man

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Contents

1 **Transport Energy Efficiency and Electric Vehicle Trends**

2 **Current State in Tonga**

3 **Next Steps for NREL's Support to Tonga**

Transport Energy Efficiency & Electric Vehicle Trends



Photo: Prateek Joshi (NREL)

Global Electric Vehicle Trends

2040 EV Stock Projections



Passenger cars: 727 million (75% of global sales)



Commercial vehicles: 15.5 million (54% of global sales)



Buses: 1.7 million (83% of global sales)



Two- and Three-Wheelers: 758 million (83% of global sales)

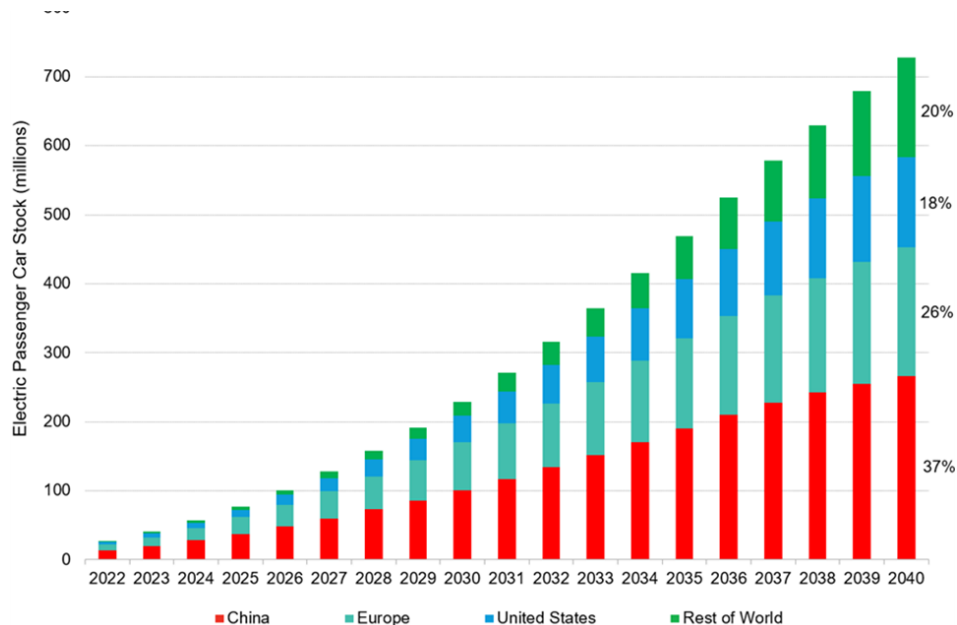


Figure. Global electric passenger car stock projection, 2022-2040

Data: Bloomberg New Energy Finance (2022)

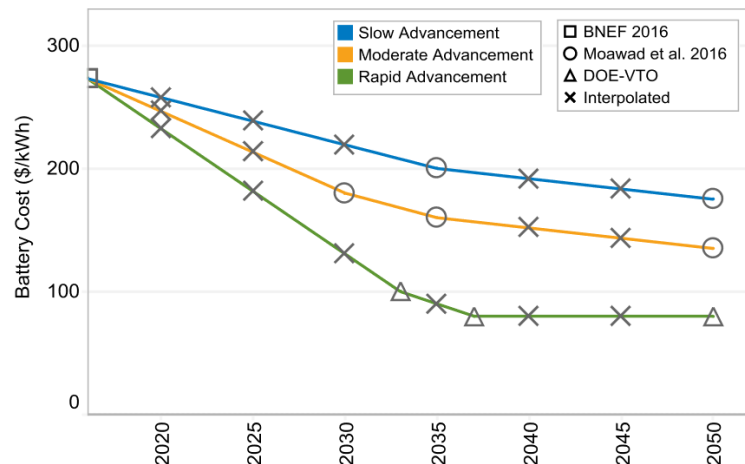
Rapid growth globally, particularly in major markets (China, Europe, U.S.)

Global Electric Vehicle Cost Trends

Cost Declines in Batteries

- Higher upfront cost of most EVs compared to internal combustion engine (ICE) counterpart is due to cost of battery.
- Battery pack prices have fallen 89% since 2010, despite recent supply chain issues.

Figure. Projected decrease in cost of batteries, 2020-2050



Source: NREL Electrification Futures Study (Jadun et al., 2017)

Battery pack price (real 2021 \$/kWh)

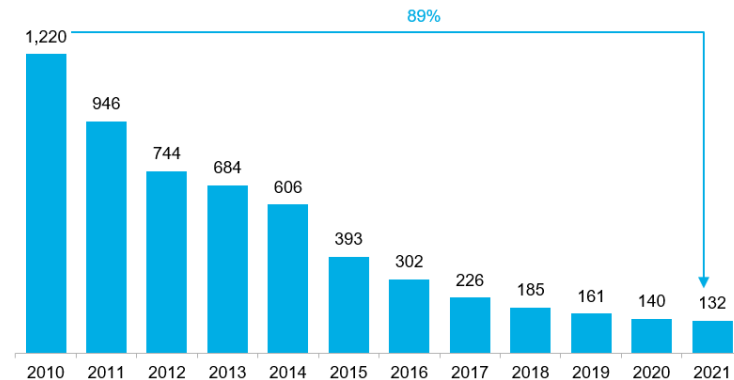


Figure. Decrease in cost of battery packs, 2010-2021

Source: Bloomberg New Energy Finance (2022)

- Unsubsidized upfront price parity expected in most vehicle segments and markets by the late 2020s.
- Already, the lifetime operational cost of owning EVs is typically lower than the ICE counterpart due to reduced fuel and maintenance expenses.

Regional Electric Vehicle Cost Trends

- Focus on electrifying buses and two-wheelers
- Electric two-wheelers have already achieved upfront price parity with ICE counterparts
- Shorter travel distances provide opportunity for smaller electric buses that are closer to price parity
- Electric taxi and ride-hailing services are likely to be more cost-effective than electric passenger cars (due to greater km driven)



Photo: Erik Nelsen (NREL)

Regional Electric Vehicle Charging Infrastructure Trends

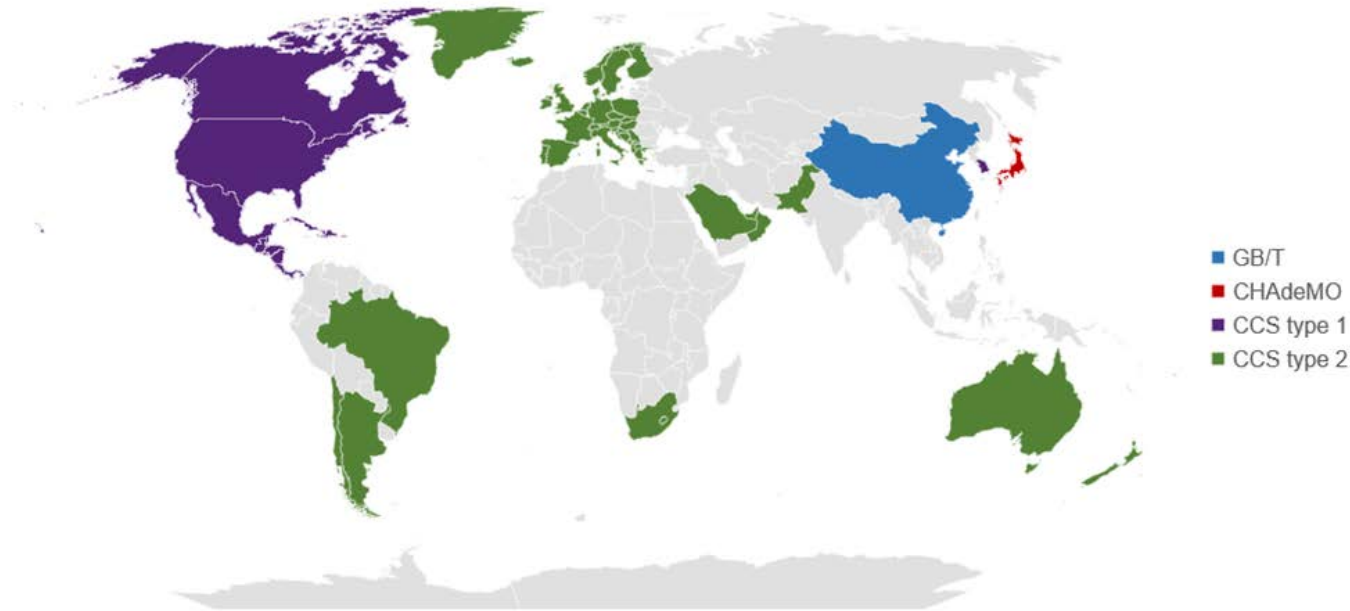
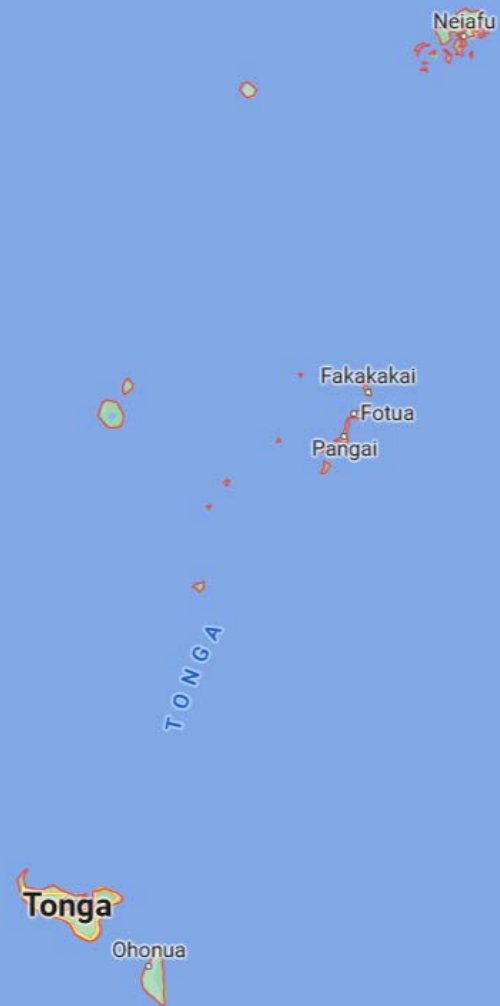


Figure. Predominant EV fast charging standards by location
Charging standards differ globally and even within a country

Regional Transport Energy Efficiency Trends

- Many emerging economies have limited regulations regarding importing used vehicles
- Some regulations include age restrictions of vehicles, import tariffs, or registration fees favoring more efficient vehicles
- Mauritius adopted a fee/rebate scheme to import more fuel-efficient vehicles, helping to result in an improvement in fuel economy of 16% from 2005 to 2015

Current State in Tonga



Current State of Transportation

- Electricity Generation: 13% of total generation came from renewable sources in fiscal year 2019-2020.
 - Goal of 70% by 2025 and 100% by 2030, which will only increase the benefits of electrified transportation.
- Transport comprises 40% of national GHG emissions.

Table. Tally of household vehicles in Tonga by type as of 2021

Vehicle Type	Number of Vehicles	Percentage of Total Vehicles
Car	12,369	56%
Van	7,454	34%
Truck	1,980	9%
Motorbike	230	1%
Bus	88	0.4%
Total	22,121	100%

Source: Tonga 2021 Census

Transportation Projections

- Vehicle-kilometers-traveled (VKT) projected to increase from 2,289 VKT/person in 2016 to 5,103 VKT/person in 2050 (including freight) in BAU scenario
- Number of vehicles estimated to grow at a rate of 1.3% between 2021 and 2035

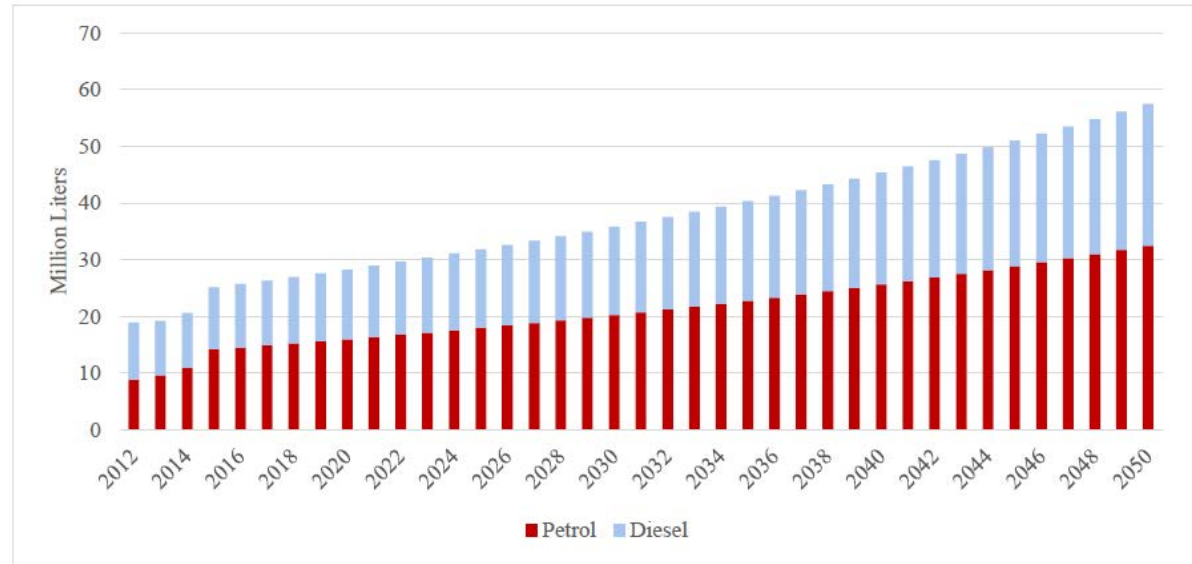


Figure. Tonga business-as-usual (BAU) transportation diesel and petrol fuel usage projections

Source: Tonga Energy Efficiency Master Plan, 2020-2030

EV Benefits in Tonga

- Greenhouse gas emissions reduction
- Local pollutants reduction (improved air quality)

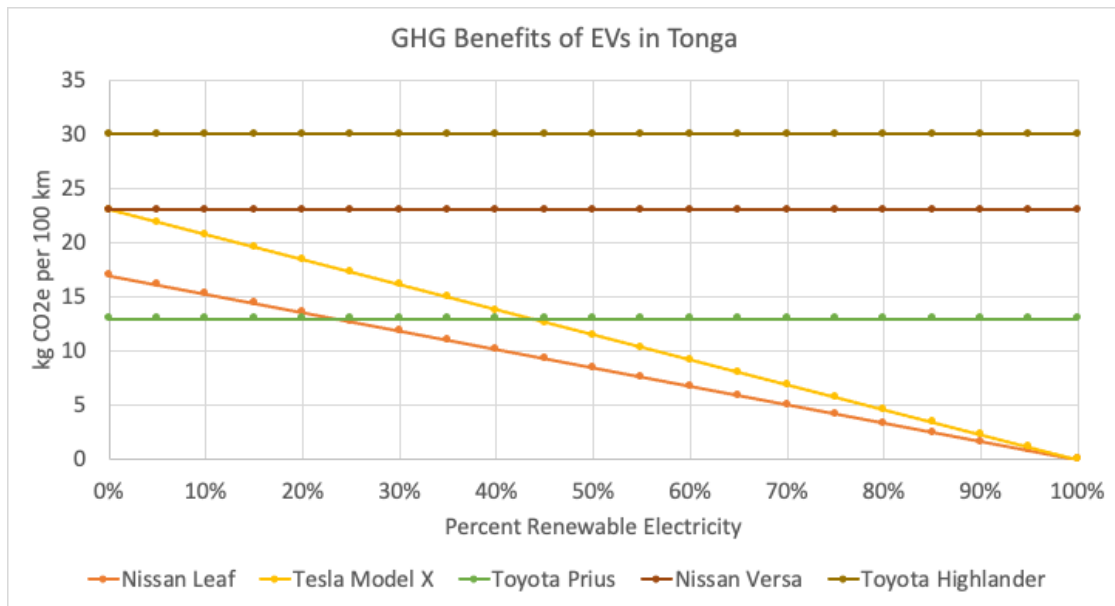


Figure. Greenhouse gas emissions benefits of electric vehicles in Tonga.

Source: Tonga Energy Efficiency Master Plan, 2020-2030

Actions in Addition to EVs

TRANSPORT

Sector Pathway Actions Over Time

1

Improved transport data collection and waste management

PRINCIPLES

Environment, Education, Autonomy, Culture & Core Values

2

Mandatory vehicle standards and incentives for more efficient vehicles through tax, fees and import tariffs

PRINCIPLES

Education, Environment, Inclusivity, Culture & Traditional Knowledge

3

Strengthening Road maintenance—Tanu Hala

PRINCIPLES

Environment

4

Decentralization of services from urban to rural areas to decrease traffic congestion

PRINCIPLES

Inclusivity, Environment, Education, Autonomy & Core Values

5

Low Emissions Vehicles

PRINCIPLES

Autonomy, Environment & Inclusivity

6

Introducing Electric Vehicles (EVs) in the municipal government fleet

PRINCIPLES

Environment, Education & Culture

7

Strengthen Sustainable Maintenance of all vehicles

PRINCIPLES

Environment

8

Implementation of Non-motorised and cycling transport options

PRINCIPLES

Environment, Traditional Knowledge and Culture and well aligned to Inclusivity, Autonomy, Education & Core Values

9

Public adoption of 50% Electric Vehicles (EVs)

PRINCIPLES

Environment, Education, Inclusivity, Autonomy & Core Values

Next Steps for NREL's Support to Tonga

NREL Support for Tonga's E-Mobility Goals



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Analysis for Transportation Energy Efficiency and Electrification Options (Policy Framework)

Estimated timeframe: December 2022 – June 2023

This activity will reflect and build from the interventions and options identified in the TEEMP, TERM+, and NREL report. The overall aim of this framework is to assist Tonga in achieving the targets outlined in the TEEMP and TERM+.

Draft Policy Framework Structure

EV Adoption

- Includes adoption of hybrids, plug-in hybrids, and battery electric vehicles
 - Private vehicles, commercial fleets, government fleets, and public transport (reflecting GGGI work)
- Could include policies such as “feebate schemes”, tax incentives, purchase subsidies, etc.
- Vehicle shipping and procurement policies
- Battery end-of-life treatment

EV Charging Infrastructure

- Standards and guidelines
 - Applicability of different standards in use throughout the world to Tonga
- Incentivizing the building, operating, and maintenance of EV charging stations
 - Types of charging stations, locations for stations, and business models
- Incentivize charging management systems to minimize grid impact
 - Smart charging and time-of-use pricing

Vehicle and Transport System Fuel Efficiency

- Vehicle fuel economy requirements and vehicle import or registration tariffs
- Decreasing the vehicle-kilometers-traveled (VKT) required to get a given amount of transportation service
 - Public transit (including on-demand transit)
 - Ridesharing
 - E-bikes
- Relationship between transportation system efficiency and EVs

Q&A / Thank You

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