FINAL REPORT

Study on the Challenges and Opportunities of EV Development in the Three Cities of the Philippines: The Case of Cities of Cauayan, Borongan and Ormoc

ESCAP
Economic and Social Commission for Asia and the Pacific

Study on the Challenges and Opportunities of EV Development in Three Cities of the Philippines; Cauayan, Borongan and Ormoc

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This analytical study is the result of collaboration of the Energy Division, Economic and Social Commission for Asia and the Pacific (ESCAP), the three cities of the Philippines; City of Cauayan, City of Borongan and City of Ormoc, and the Isabela State University.

The report was conducted by Orlando F. Balderama. Special appreciation is expressed to the three Local Governments in providing direction and supervision for the analysis.

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A. BACKGROUND

The transport sector today is responsible for around 25% of carbon dioxide emissions from fossil fuel combustion and its share of global emissions is expected to rise to 75% by 2050. Achieving the objectives of the Paris Agreement of limiting average global temperature rise to less than 20C below pre-industrial levels will require rapid de-carbonization across all sectors including the transport sector. Additionally, the COP26 climate conference recognized that rapid, deep, and sustained reductions of emissions in the transport sector are necessary to limit global warming to 1.5°C.

Electrification of transport could be one of the options to achieve emissions reductions at the scale necessary to decarbonize transport. In fact, the electrification of transport is the most important element of the sustainable energy transition as it offers several benefits, including:

- Reducing vehicle emissions and helping to achieve the Paris Agreement;
- Serving as energy storage thereby supporting the uptake of renewable energy electricity;
- Reducing dependence on fossil fuel imports for transport which eventually increases energy security and reduces spending on foreign currency; and
- Eliminating local air pollution which will significantly improve public health in urban areas.

The Government of the Philippines has taken steps to encourage citizens to use electric vehicles. For example, the Republic Act No. 11697 or the Electric Vehicle Industry Development Act which promotes innovation in the field of clean energy and sustainable transportation might provide incentives for the electric vehicle owners. Under the Comprehensive Roadmap for the Electric Vehicle Industry (CREVI), battery electric vehicle (BEV) owners are entitled to a 30 percent discount on the motor vehicle user's charge (MVUC). This discount will also apply to EV inspection fees for the first eight years of this Act's effectivity**.**

The Sustainable Energy Transition (SET) roadmaps developed for the three cities (Borongan, Cauayan and Ormoc) have strongly recommended to increase the adoption of electric vehicles. The roadmaps stressed that despite the decline in EV costs, accelerating the transition to e-mobility at scale will require knowledge of technological options, the economic feasibility of switching from Internal Combustion Engines (ICEs) to EVs, as well as the development of codes and standards, and fiscal, regulatory and infrastructure policy frameworks to support the development of an EV ecosystem.

To support the Government of the Philippines with an in-depth assessment of challenges and opportunities to introduce EVs in the public transport system, ESCAP is partnering with the Isabela State University to undertake an analytical study on EVs in the three cities with technical support from experts.

B. PROJECT OBJECTIVES

The overall objective is to undertake an analytical study on the challenges and opportunities of EV development for the public transport sector in three cities of the Philippines; Cauayan, Borongan and Ormoc. The specific objectives of the project are to:

- Review and analyze the overall structure of EVs in public transport in the selected cities, infrastructure, challenges, and barriers to develop EVs;
- Identify potential areas in these cities for further development for EV promotion; and
- Propose recommendations to promote EVs; and identify pathways for moving forward towards greater adoption of EVs in public transport.

C. METHODOLOGY

The study adopted the following methods break down under the three components as follows:

1. Organization and conduct of inception workshops on a hybrid platform

   The following activities were undertaken:

   a. Coordination with concerned cities through their focal persons by the UNESCAP and Isabela State University and secure their agreement on the conduct of the study including activities, timetable, identification of stakeholders and support to the over-all implementation of the project;

   b. Preparation of detailed work plan and schedule of activities

   c. Prepared list of stakeholders and issuance of invitation letters;

   d. Conducted inception workshop on hybrid platform to identify challenges and opportunities for the selected three cities in relation to promoting EVs for public transport;

   e. Preparation of workshop proceedings for each city

2. Conduct an analytical study

   The following activities were undertaken:

   a. Desk reviewed on technologies, policies, business models, regulatory issues, etc. in relation to promoting EVs for public transport. Both new electric vehicles and the possibility of converting ICE to electric were considered;

   b. Synthesized result of workshop to identify challenges and opportunities for the selected to promote EVs for public transport with focus given on tourist and community hot spots.

   c. Identifies with LGU and transport group ideal routes categories for tricycle, mini-bus and bus for the detailed analytical study;

   d. Collected data from the cities and/or stakeholders on the following data/parameters.

   A matrix table to consolidate all the data were prepared.

   i. Number of routes per category of vehicles (the categories are bus, minibus, and motorcycle);

   ii. Number of vehicles operate per route per category;

   iii. Average distance per route and frequency per day for bus and minibus;

   iv. Average distance per day for motorcycle;

   v. Fuel consumption per km per category;

   vi. Load factor (average number of passengers per vehicle-km) per category;

   vii. Passenger fare per km per category;

   viii. Fuel cost per km/per month per category;

   ix. Maintenance cost per month per category;

   x. Other costs (e.g. administrative, etc.) per month per category;

xi. Cost of conversion from ICE to electric for all categories;

xii. Indicative increase of sales value after the conversion;

3. Organization and conduct of a policy dialogue

The following activities were undertaken:

a. Identified with ESCAP and the city stakeholders were invited in this dialogue;

b. Presented results and findings from the study;

c. Collected and compiled comments from the dialogue (if any) and incorporated them to update the study report.

D. RESULTS AND DISCUSSIONS

D.1. Inception Workshop Proceedings

Order of Presentations for the Three Cities

a. E-trikes in Cauayan City: Smarter Mobility for a Smarter City

Dr. Precila C. Delima
Executive Officer, ISU Cauayan Campus/EV Charm Project Leader

Dr. Precila Delima, the Executive Officer of ISU Campus and the Project Leader of the project "E-trikes in Cauayan City: Smarter Mobility for a Smarter City". The primary objective of the said project is to establish the pre-commercialization requirements of e-trikes. Based on the result of market validation, it was determined that aside from the higher cost of EVs as compared to gas-powered vehicles, the biggest barrier to the adoption of EVs among consumers is the time that it takes for EVs to recharge. As such, the availability of fast-charging stations is a crucial factor in attracting people to shift from gas-powered vehicles to EVs. She also showed the comparative income analysis where the of drivers for e-trikes had a higher net income than that of the regular gasoline-powered tricycles. The project has a positive Net Present Value (NPV) which implies that the Isabela State University and the Local Government Unit of Cauayan City should continue investing in the project. Moreover, the other economic and environmental benefits of e-trikes are not yet included in the analysis, which could be very high in the long term.

b. R&D Program in the Development of Electric Vehicle: The Case of Electric Mobility Center in the Philippines

Dr. Florentina S. Dumlao
e-Mobility Research and Development Center, Cagayan State University

The "R&D Program in the Development of Electric Vehicle: The Case of Electric Mobility Center in the Philippines" is implemented under the Electromobility Research and Development Center (eMRDC) in Region 02 of the Cagayan State University (CSU) in support of the e-vehicle industry in the Philippines and is supported by the Department of Science and Technology (DOST).

The program has developed two prototypes of e-trikes with features shown in Table 1. These e-trikes were tested in compliance with the manufacturing of e-vehicles such as the radiated and conducted immunity test, brake test and passed the standards. In addition, there is an ongoing fabrication and assembly of the Prototype 3 e-trike with a composite body using hybrid fiber glass-abaca panels which is part of the technology transfer of Abaca-fiber reinforced composite technology.

Table 1. Features of the e-trikes developed by the eMRDC.

Features	Prototype 1	Prototype 2
Body	Metal	Composite (Pure fiber glass)
Capacity	1 driver and 6 passengers	1 driver and 6 passengers
Maximum Speed	45 kph	45 kph

Features	Prototype 1	Prototype 2
Range on a single charge	40 km (full), 55 km (half)	70 km (full), 80 km (half)
On-board charging time	2-3 hours	3-4 hours
Battery:	60AH LifeP04 72V	100AH LifeP04 72V
Prime Mover	5kW 3-Phase Induction Motor	5kW Electric Motor

The conversion of conventional tricycles into e-trikes is also one of the initiatives of the program where the existing tricycle body frame is adapted and will replace the gas-fed engine and other parts associated with its gas-fed operation with an electric conversion kit. The conversion will have the benefit of e-tricycle at a lower investment cost and lower operation and maintenance costs. Moreover, it will provide an avenue for greening the transport industry. Further, one of the next steps that will be conducted is the conversion of conventional passenger bus to electric public utility bus (ePUB)".

c. Presentation of the Study on Challenges and Opportunities of EV Development in the City of (Cauayan, Ormoc, and Borongan) and Data Collection, Timelines, Workplan and Milestone

Dr. Orlando F. Balderama
Isabela State University/UNESCAP Focal Person

Dr. Orlando F. Balderama presented the "Study on Challenges and Opportunities of EV Development in the three cities (Cauayan, Ormoc and Borongan City)". The study is a follow-up activity of the SET Roadmap of Borongan City wherein it was strongly recommended in the said roadmap the increase in the adoption of e-vehicles in the city. Also, the study is initiated by the ESCAP with the ISU as a partner, to support the Philippine Government with an in-depth assessment of challenges and opportunities to introduce EVs in the public transport system.

Open Forum

The following issues and concerns were raised during the separate inception meetings conducted with the three cities: Cauayan, Ormoc and Borongan.

ISSUES/CONCERNS	RESPONSE
Cauayan City	
Where will be the basis of the study on the number of vehicles, average distance per route and others?	It will be based on the operators of the tricycle. There are established routes defined by the Local Government Unit (LGU). For the buses, it will be an inter-province operation of buses that are for the transport regulatory board.

ISSUES/CONCERNS	RESPONSE
What type of methodology will we be going to use for this study?	For the methodology, the first one is Phase 1 which is a participating exercise to get inputs to the stakeholders and to capture the problems and the factors hindering the adoption of the EVs. Phase 2 is the analytical study in terms of financial feasibility to all the categories (tricycle, bus and jeepney). Comprehensive review of the existing policies and laws to look at the gap in terms of the national policies and thrust of the government and others. Last part is the dialogue or participatory exercise to look at the completeness of this study to ensure more are on to this point onwards. But the very purpose of this is to write down the detailed activities and analytical frameworks including some formulas and others.
Additional information, on the cooperation of DOST and CSU with e-Mobility Center, aside from the development of e-trike and e-conversion of tricycle to e-trike, CSU also developed some ride-hailing app that can be put in different tricycles so that the commuters can easily access using the app. Also, the fast-charging station in CSU is a solar PV system.	Totally agree with the fact that charging electric vehicles with conventional and very emission-intensive electricity is not a good idea. We should try to focus on renewable energy installation for the charging system.
More updates on the e-conversions	CSU already completed the study on conversion of Internal Combustion Engine (ICE) to electric tricycle. They are experimenting with another one as part of how they can improve the technology they have right now. Now, they have the Sprint program partly conducted by the DOST in relation to how they can smoothly transfer the technology.
Is the model (ride-hailing apps) available publicly?	It's being used for other LGUs, but through the academic institutions. It's with the University of the Philippines.
Is there any plan for electrification of the transport sector in the local areas, to be more specific in the city of Cauayan area or any municipalities?	The local government unit of Cauayan City already has a special ordinance to have at least 100 franchises of e-Trikes.

ISSUES/CONCERNS	RESPONSE
Insights on jeepneys which is also an important mode of transportation.	For the city of Cauayan, the R&D that was already conducted was on e-Tricycle and have not conducted any study yet as to the feasibility of electrification of jeepneys. But it is also a concern for Cauayan City. The e-jeepneys will not be far in the future. This is something low-hanging for them for their e-trike. But nationwide, there's a push. Going back, if you want to discuss electric jeepneys, nationwide, there are pushes on it. The transition from the traditional jeepneys to electric is more expensive. The price is really something that the market's really looking at. That's where the resistance is coming from. The price is still on the higher end, then the limitation of the charging stations, then the range anxiety. Those are the things that people really consider. There are already locally-manufactured Jeepney, e-Jeepney and a number of local manufacturers ave already been engaged in local manufacturing of jeepneys. For the charging stations, it's easy to install a fixed charging station as far as the Jeepney, because Jeepney has a specific route and there are fixed points that you can already place and locate the charging stations. The constraints right now are the Jeepney operators are looking for incentives and financial assistance and initial investment costs
Ormoc City	
Why is an electric cooking stove (ECS) costing US$107 recommended in the sustainable energy transition roadmap compared to an improved cooking stove with a lower cost (ICS) of only US$28.	The ECS is recommended, though the cost is higher than that of the ICS, because the ECS is the most appropriate long-term clean cooking solution in achieving the SDG7 goal because it is cost-effective, has zero GHG emissions and indoor air pollution, has minimal monitoring and follow-up, and no fossil fuel import dependency.
Is the cost of electricity in the Philippines considered?	Yes.
Borongan City	
Once the e-trike prototypes are ready and will be required to get the licenses road permits for those vehicles as well before they can be brought on the road.	The license is taken care of by the Land Transportation Office (LTO) of the Philippines and with the support of the DOST, DOE and DOTr and of course the Department of Transport. Having this all with the existence of the laws of the country such as the EVIDA and the CREVI, are all taken care of as part of the support to the electronic vehicle promotion in the Philippines.

ISSUES/CONCERNS	RESPONSE
The Php 650,000.00 cost of the e-trike is not yet attainable at the end of Borongan City. Even if hydro energy is developed at a discount that will be provided by the LGU will not entice the tricycle operators and drivers to convert to electric tricycles, because it is not affordable for them. But Borongan City still forgo their desire to purchase one unit, so that at this early stage, they can showcase it in the city. And of course, so that they will also have the moral ascendancy over the Abaca Fiber Authority in the region, it might somehow reduce the cost in producing the tricycle.	As part of the deliverables of CSU, they really would like to provide the city with a unit. There is another proposal where they are looking at Region 8 to be one of those who can also manufacture the e-trike. The DOST can assist CSU and Borongan City on how they can transfer the technology to the metal industry and abaca industry in the city through the Technology Licensing Agreement so that whatever production in the region will be solely distributed in the region and nearby regions and spread the technology throughout the Philippines.
What would be the tentative cost that you are estimating?	The cost is Php 667,000 pesos per unit. But for the manufacturers, with CREVI and EVIDA, there are packages of tax incentives as well as price incentives for those who will be producing electric vehicles. So, manufacturers can avail of that
Would the motor that will be put into this tricycle can carry that load? If the tricycle cup is redesigned, this will take time since most of the existing tricycle cup in Borongan is designed this way.	As for the design of the tricycle, Tuguegarao City is the same as Borongan City. For the conversion kit, it is running at around 100,000.
Passenger capacity of the e-trike prototype model.	The model has a capacity of six passengers plus one driver.
Regarding the conversion of the tricycle, how is the operation of the converted tricycle? Is it going to change the engine motor to an electric motor? How about the other components?	The gas tank will be replaced by an electric engine. Some parts are the ones which will be replaced by the conventional tricycle.
The cost of the converted tricycle is much more expensive than the cost of a brand-new conventional tricycle.	A viability study was already conducted by CSU and there are data comparing the tricycle using gas and electricity. A mileage test was also conducted and for mileage efficiency, using the 2-stroke tricycle consumed Php 3.21 per kilometer while the 4-stroke engine consumed Php 2.36 per kilometer at Php 75.00 per Liter. The converted trike consumed Php 0.88 per kilometer at Php 11.00 per kWH. The use of the converted trike is 3.6 times better than the 2-stroke and 2.6 times better than the 4-stroke engine tricycle. Also, by using the converted vehicles, the environmental aspect is saved. As for the effect on traffic conditions, the converted trike does not consume in an idle state. An economic analysis comparing the

ISSUES/CONCERNS	RESPONSE
	conventional and the converted trikes was also conducted.

D.2. Electric Vehicle Analytical Study

A. Overview of City's Land Transportation

A.1. Cauayan City

Cauayan City's land transportation system serves as a vital component of its local infrastructure, facilitating the movement of people and goods within the urban and suburban areas. The city's transportation landscape typically comprises a mix of public and private vehicles, contributing to the overall mobility of its residents. Cauayan City's Road passenger public transportation is subdivided into three categories- tricycle, jeepneys and buses.

Tricycle is one of the common means of public transportation, along with jeepneys. According to the Local Government Unit of Cauayan, there are almost 6,000 units of tricycles only in the city. Tricycles can accommodate a maximum of 6 passengers. Inside the city, tricycles are often shared where passengers' fares are calculated per passenger after the distance traveled.

Jeepneys are serving as the most popular public transportation in Cauayan City connecting to other municipalities in the Isabela Province such as municipalities of Reina Mercedes, Gamu, Ilagan, Benito Soliven, San Mariano, Cabatuan, San Mateo, San Manuel and Roxas.

Buses are a popular mode of long-distance transportation. Most cities and towns within and outside the region can be reached by bus.

A.2. Ormoc City

Given the location of Ormoc City and its role as a major gateway, the city is serviced by buses, public utility jeepneys (PUJs), utility van (UV) express/van for hire, tricycles, and habal-habal (motorcycles for hire) although the latter is not regulated by the Land Transport Regulatory Board (LTFRB).

The primary mode of transport in the city center and the urban barangays is the motor cab or tricycle. To date, there were 1,488 registered conventional tricycles plying between the city proper and the urban barangays with a capacity of 6 passengers. The PUJs, mini-buses, and UVs operate inter-barangay and inter-municipality routes, providing linkage with the city center. Public utility buses (PUBs) provide inter-city and inter-regional transport. PUB routes connect Ormoc to as far south as Davao in Mindanao and as far north as Fairview, Cubao, and Pasay in Luzon. All northbound buses pass through Tacloban to get back on the Pan-Philippine Highway.

A.3. Borongan City

Borongan City, the capital of Eastern Samar in the Philippines, boasts a picturesque setting along the eastern coast of Samar Island. The city is recognized for its cultural heritage and natural beauty. Presently, Borongan City's public land transport system is an essential component of its urban mobility, catering to the diverse transportation needs of its residents and visitors. The city boasts a network of public buses, tricycles, and jeepneys that weave through its streets, providing affordable and accessible transportation options. Commuters in Borongan rely on these modes of transport to navigate the city, with well-established routes connecting key residential, commercial, and institutional areas. Tricycles are commonly

employed for short-distance journeys within the city limits, while vans and buses provide connectivity to neighboring cities and towns. The public land transport system plays a crucial role in fostering connectivity, facilitating daily commutes, and contributing to the overall accessibility and vibrancy of Borongan City.

B. Data Collection

The project team collected primary data through an interview with the vehicle operators/drivers with the use of a data matrix. Secondary data were obtained from other research related to the study.

B.1. Cauayan City

Usually, 2 to 3 passengers are enough for the driver to bring the passengers to their destination with a minimum fare of Php 15.00 per passenger and an additional fare depending on the distance to be ridden. Tricycle drivers spend Php 80.00 to 200.00 for the fuel for riding the tricycle daily and a monthly of Php 250.00 to 500.00 for the change oil and other maintenance activities. Among the routes within the city, the Isabela State University to Cauayan Campus to City Hall route is the identified route for this study for the tricycle category with a distance of approximately 1.15 km.

Among the jeepney routes, the identified route is from Cauayan City to San Mariano with a distance approximately 37 km. The Cauayan City to San Mariano route will touch five towns including Cauayan and San Mariano. There are 36 units of jeepneys operating for this specific route. Only 22 units pass this route daily. The jeepney drivers have their operation schedules. One jeepney consumed Php 1,800.00 per route daily and a monthly maintenance cost of Php 1,500.00. A jeepney can accommodate 12 to 18 passengers for one trip with a minimum fare of Php 20.00 and additional fare subject to the distance per passenger. The fare for Cauayan City to San Mariano is Php 70.00 per passenger.

One of the routes inside the Cagayan Valley region is the Cauayan City to Tuguegarao City route. This route touches 10 towns (including Cauayan City and Tuguegarao City) of the provinces of Isabela and Cagayan with a distance of approximately 105 km. The fares on buses are regulated and generally based on distance. Provincial buses have a minimum fare of Php 30.00 and additional fare depending on the distance per passenger. Buses can accommodate 40 to 50 passengers per trip with an average fuel consumption of 25 to 30 liters per 100 km.

The identified route, distance, number of vehicles that operate, load factor and type of fuel used per type of transport is shown in Table 2.

Table 2. Collection of data for the different types of public transport in the City of Cauayan, 2023.

Type of Transport	Identified route	Distance * (km)	Load Factor	Type of Fuel Used
Tricycles	Isabela State University (Cauayan Campus)-Cauayan City Hall	1.15	2.5	Gasoline
Jeepneys	Cauayan City-San Mariano	37	15	Diesel

Type of Transport	Identified route	Distance * (km)	Load Factor	Type of Fuel Used
Buses	Cauayan City-Tuguegarao City	105	45	Diesel

*Distance for the identified routes
Load Factor (average number of passengers per vehicle-km)

Table 3 shows the daily income of the public drivers per type of vehicle in Cauayan City. The conventional tricycle, powered by gasoline, incurs a fuel cost of Php 220.00 at Php 55.00 per liter, whereas utilizing e-trike results in a notably lower charging expense of Php 70.00. The calculation of the e-trike charging cost considers the daily energy requirement of 6 to 8 kWh, considering the electricity rate in Cauayan City as of October 2023, which stands at Php 13.13 per kWh. This leads to a substantial income advantage for the e-trike driver, amounting to Php 275.00 (90%). The disparity is primarily rooted in the operational expenses, demonstrating that the conventional tricycle bears a comparatively higher operating cost than its e-trike counterpart.

Table 3. Driver's daily income per type of public vehicle in Cauayan City, 2023.

	e-Vehicles	Conventional Vehicles
Tricycle		
Gross income	Php 700.00	Php 600.00
Operating Cost		
Fuel/charging cost	Php 70.00	Php 220.00
Maintenance Cost	Php 40.00	Php 75.00
Net income (Daily)	Php 590.00	Php 305.00
Jeepney		
Gross income (18 passengers x 2 trips Php 70.00)	Php 2,520.00	Php 2,520.00
Operating Cost		
Fuel/charging cost	Php 1,700.00	Php 2,000.00
Maintenance Cost	Php 75.00	Php 100.00
Net income (Daily)	Php 745.00	Php 420.00
Bus		
Gross income (40 average passengers x 6 trips Php 300.00)	Php 24,000.00	Php 24,000.00
Operating Cost		
Fuel/charging cost	Php 3, 577.38	Php 3,600.00
Maintenance Cost	Php 500.00	Php 1,000.00
Net income (Daily)	Php 19,922.62	Php 19,400.00

B.2. Ormoc City

For the identified route of tricycles considered in this study, from the terminal to Ormoc City Hall and vice versa approximately 1.5 km distance, an average of 2 to 3 passengers is enough for the driver to bring the passengers to their destination with a minimum fare of Php 15.00 per passenger. Tricycle drivers spend daily fuel expenses of Php 300.00 to Php 350.00 and allot

Php 250.00 to Php 500.00 monthly for maintenance expenses for changing oil and bearing replacement. Each driver has an average daily net income of Php 200.00 to Php 300.00 which, according to them, is just enough to feed their own family.

For UVs, particularly for the Ormoc City to Tacloban route, approximately 109 km distance, there were an average of 2 trips passing the said route per UV per day and consuming fuel amounting to an average of Php 1,790.00. With a UV capacity of 14 passengers and a regular fare of Php 200.00 (Php 180.00 for senior citizens and persons with disabilities), there is an estimated net income of Php 3,000.00, of which 70% will be given to the operator and 30% will be the driver's share. For the maintenance costs, operators apportion an amount from their net income for vehicle check-ups, change oil, change tires, and brake pad replacement amounting to Php 3,000.00 monthly or Php 100.00 daily.

Table 4. Driver's daily income per type of public vehicle in Ormoc City, 2023.

	e-Vehicle	**Conventional Vehicle**
Tricycle Gross income (6 passengers x 6 trips Php 15.00)	Php 540.00	Php 540.00
Operating Cost Fuel/charging cost Maintenance Cost	Php 100.00	Php 350.00
Net income (Daily)	Php 458.00	Php 190.00
Van	*22 Passengers-capacity*	*14 Passengers-capacity*
Gross income (at 2 trips x Php 200.00 fare)	Php 8,800.00	Php 5,600.00
Operating Cost Fuel cost Charging Cost	Php 400.00	Php 1,790.00
Net income	Php 8,400.00	Php 3,810.00

**Source: Nacino, 2014 – e-jeepney daily power requirement = 18 KWh*

B.3. Borongan City

The conventional tricycles operate on the identified route from Borongan City proper to Eastern Samar State University, Borongan Campus, covering 7.5 km. This identified route is one of the routes in the city that is vital for daily commuting, serving the transportation needs of the community, especially students and faculty. A fleet of 300 possible conventional tricycle units is in operation daily, making an average of three round trips between Borongan City proper and Eastern Samar State University, Borongan Campus. This consistent frequency ensures accessibility for passengers throughout the day. The conventional tricycles consume 3 liters of gasoline per day to traverse the specified route. Gasoline, a common fuel type for these tricycles, powers their internal combustion engines, allowing for efficient operation. Passengers are charged a fare of Php 20.00 per trip, contributing to the revenue generated by the tricycle operators. With a fuel cost of Php 55.00 per liter, the daily fuel expenses for each tricycle can be

calculated based on the 4 liters consumed daily. This cost factor significantly influences the overall operational expenses. To ensure the tricycles' reliability and safety, average monthly maintenance cost of Php 850.00 is incurred. This cost covers routine maintenance activities, repairs, and upkeep of the tricycle fleet. Each driver has an average daily net income of 200.00 for their family.

For the UV express services in Borongan City operate in the different neighboring towns and cities. The identified route, from Borongan City to Tacloban City, covers a substantial distance of 192 km. This route plays a pivotal role in regional transportation, providing connectivity between the two cities. With two round trips per day, the UV express service offers a dependable transportation option for individuals commuting between Borongan City and Tacloban City, and other neighboring municipalities. The vans collectively consume 45 liters of diesel per day to cover the entire route in a one-round trip. Passengers utilizing the van service are charged a fare of PHP 461.00 per trip to Tacloban City. With a fuel cost of Php 64.00 per liter, the daily fuel expenses for each van can be calculated based on the 45 liters consumed on a one round trip. This cost is a substantial factor influencing the overall operational expenses of the van service. To maintain operational reliability and safety, an average monthly maintenance cost of Php 12,000.00 is incurred. This cost encompasses routine maintenance, repairs, and other necessary upkeep to ensure the vans remain in optimal condition.

The bus service connects Borongan City to Tacloban City, covering a significant distance of 192 km. This route serves as a crucial transportation link between the two cities, facilitating regional connectivity. Two buses operate on this route daily, making a round trip between Borongan City and Tacloban City. The frequency ensures regular and reliable transportation for passengers traveling between these two key locations. The buses consume a total of 90 liters of diesel per day to cover the identified route. Passengers are charged a fare of Php 300.00 per trip to Tacloban City from Borongan City and vice versa, reflecting the extended distance and the convenience of bus travel. The fare contributes to the revenue generated by the bus service, covering operational costs and ensuring sustainability. The daily fuel expenses for each bus can be calculated based on the 90 liters consumed with a fuel cost of Php 64.00 per liter. This cost is a significant factor in determining the overall operational expenses of the bus service. To ensure the buses' operational reliability and safety, a monthly maintenance cost of Php 15,000.00 is incurred. This cost covers routine maintenance, repairs, and other necessary maintenance to keep the buses in optimal condition.

Table 5. Driver's daily income per type of public vehicle in Borongan City compared to EV's, 2023**.**

	e-Vehicle	Conventional Vehicle
Tricycle		
Gross income (6 passengers x 6 trips Php 20.00)	Php 600.00	Php 600.00
Operating Cost		
Fuel/charging cost	Php 87.72	Php 220.00
Maintenance Cost	Php 50.00	Php 75.00
Net income (Daily)	Php 462.28	Php 305.00
Van		
Gross income (12 passengers x 2 trips Php 70.00)	Php 11,000.00	Php 11,040.00
Operating Cost		
Fuel/charging cost	Php 1,785.00	Php 2,880.00
Maintenance Cost	Php 75.00	Php 100.00
Net income (Daily)	Php 9,140.00	Php 8,060.00
Bus		
Gross income (40 average passengers x 6 trips Php 300.00)	Php 24,000.00	Php 24,000.00
Operating Cost		
Fuel/charging cost	Php 5,713.92	Php 5,760.00
Maintenance Cost	Php 500.00	Php 1,000.00
Net income (Daily)	Php 17,786.08	Php 17,240.00

C. Financial and Economic Analysis

This analysis undertakes a comparative examination of daily income between conventional and electric public vehicles, with a particular focus on tricycles, jeepneys, and buses. By accessing necessary factors such as operating costs, maintenance expenses, and net income, the aim is to illustrate the economic dynamic characteristics of conventional public vehicles from their electric counterparts. The data gathered from the three cities: Cauayan, Ormoc, and Borongan, were subjected for financial and economic analysis. This exploration seeks to provide insights into the feasibility and advantages of adopting electric vehicles for the public drivers in terms of daily income generation. The assessments were based on incremental wherein the electronic vehicle is the based value. The operations of all vehicles would be assumed at 215 days a year, with a discount rate of 12% per annum, and projected for 10 years.

C.1. Cauayan City

The e-trike vs. conventional tricycle in Cauayan City has obtained an incremental benefit of Php 285.00 per day. It has an annual incremental income of Php 61,275.00 with a present accumulated value of Php 346,217.42 for 10 years of operation discounted at 12% per annum. It has an incremental Return on Investment (ROI) of 35.22%, Profitability Index (PI) at 12% per annum of 1.99, Net Present Value (NPV) at 12% per annum of Php 172,217.42, and Internal

Rate of Return (IRR) of 18.94% (Tables 6 and 7). All indicators are favorable indicating that the e-trike operation in Cauayan City has a better opportunity cost of investment.

Table 6. Financial and Economic Assessment of e-Trike in Cauayan City.

Particular	e-trike	Conventional tricycle	Incremental Cost/Benefits
Investment Cost	350,000.00	176,000.00	174,000.00
Gross Income (per day)	700.00	600.00	100.00
Operation & Maintenance Cost (per day)	110.00	295.00	(185.00)
Net income (per day)	590.00	305.00	285.00

Table 7. Statement of Incremental Cost and Benefits of e-Trike in Cauayan City.

Year	Incremental Value	Discounted Value of Increment Cost/Benefits
	174,000.00	(174,000.00)
1	61,275.00	54,709.82
2	61,275.00	48,848.05
3	61,275.00	43,614.33
4	61,275.00	38,941.37
5	61,275.00	34,769.08
6	61,275.00	31,043.82
7	61,275.00	27,717.70
8	61,275.00	24,747.94
9	61,275.00	22,096.38
10	61,275.00	19,728.91
Total Present Value of Incremental Benefits		**346,217.42**
Discounting Factor	12%/Annum	
Number of operating days a year	215 Days	
Summary of Results:		
Return on Investment (ROI)	35.22%	
Profitability Index	1.99	
Net Present Worth	172,217.42	
Internal Rate of Return	18.94%	
Remarks :	Favorable	

For e-jeepney operation performance in Cauayan City, it is not favorable based on the results of economic analysis. It has a small incremental income of Php 325.00 per day or Php 69,875.00 yearly (Tables 8 and 9). These inflows obtained a total present value of incremental benefits of Php 0.39 million from its 10 years of operation discounted at 12% per annum. An

ROI (20.80%/annum), PI at 12% (1.18:1), and positive NPV at 12% (Php 0.058 million) indicated that the e-jeepney investment is favorable. However, the IRR (yield) of 3.69% is below the 12% hurdle rate which indicates that e-jeepney investment is not a good opportunity in the said place.

Table 8. Financial and Economic Assessment of e-Jeepney in Cauayan City

Particular	e-jeepney	Conventional Jeepney	Incremental Cost/Benefits
Investment Cost	2,800,000.00	2,464,000.00	336,000.00
Gross Income (per day)	2,520.00	2,520.00	-
Operation & Maintenance Cost (per day)	1,775.00	2,100.00	(325.00)
Net income (per day)	745.00	420.00	325.00

Table 9. Statement of Incremental Cost and Benefits of e-Jeepney in Cauayan City

Year	Incremental Value	Discounted Value of Increment Cost/Benefits
0	336,000.00	(336,000.00)
1	69,875.00	62,388.39
2	69,875.00	55,703.92
3	69,875.00	49,735.64
4	69,875.00	44,406.83
5	69,875.00	39,648.95
6	69,875.00	35,400.85
7	69,875.00	31,607.90
8	69,875.00	28,221.34
9	69,875.00	25,197.63
10	69,875.00	22,497.88
Total Present Value of Incremental Benefits		**394,809.33**
Discounting Factor	12%/Annum	
Number of operating days a year	215 Days	
Summary of Results:		
Return on Investment (ROI)	20.80%	
Profitability Index	1.18	
Net Present Worth (Php)	58,809.33	
Internal Rate of Return	3.69%	
Remarks :	Unfavorable	

The case of the e-bus vs diesel bus in Cauayan City is also unfavorable in terms of financial and economic analysis. This is due to greater investment in e-bus which is about 3 times higher than ordinary bus. Furthermore, the generated financial benefits are almost the same with ordinary buses. The e-bus obtained only Php 522.62 per day or Php 112,363.30 per year

incremental income with their counterpart vehicle. Its ROI has 0.68%, below 1 PI at 12% ratio of 0.04:1, negative NPV at 12% of Php15.85 million, and negative IRR of 39.39%.

Table 10. Financial and Economic Assessment of e-Bus in Cauayan City

Particular	e-bus	diesel bus	Incremental Cost/Benefits
Investment Cost	25,300,000.00	8,815,000.00	16,485,000.00
Gross Income (per day)	24,000.00	24,000.00	-
Operation & Maintenance Cost (per day)	4,077.38	4,600.00	(522.62)
Net income (per day)	19,922.62	19,400.00	522.62

Table 11. Statement of Incremental Cost and Benefits of e-Bus in Cauayan City

Year	Incremental Value	Discounted Value of Increment Cost/Benefits
0	16,485,000.00	(16,485,000.00)
1	112,363.30	100,324.38
2	112,363.30	89,575.33
3	112,363.30	79,977.98
4	112,363.30	71,408.91
5	112,363.30	63,757.95
6	112,363.30	56,926.74
7	112,363.30	50,827.45
8	112,363.30	45,381.65
9	112,363.30	40,519.33
10	112,363.30	36,177.98
Total Present Value of Incremental Benefits		**634,877.71**
Discounting Factor	12%/Annum	
Number of operating days a year	215 Days	
Summary of Results:		
Return on Investment (ROI)	0.68%	
Profitability Index	0.04	
Net Present Worth	(15,850,122.29)	
Internal Rate of Return	-39.39%	
Remarks :	Not favorable	

C.2. Ormoc City

The e-trike vs. conventional tricycle in Ormoc City has an incremental cost of investment of Php 174,000.00 and incremental income of Php 250.00/day or Php 53,750.00/year. In a ten-year analysis, this can have a present value of incremental benefits of Php 303,699.49. All

the financial and economic indicators are favorable. The incremental return on investment will be 30.89% which is greater than the hurdle rate of 12% per annum. The profitability index at 12% is greater than 1 (1.75:1), positive net present value at 12% per annum of Php 129,699.49, and an incremental yield of 14.59% which is higher than the said hurdle rate. The e-trike investment is favorable in this place since it has an ROI of Php 0.30 for every peso cost and yields Php0.14 per peso investment (Tables 12 and 13).

Table 12. Financial and economic assessment of e-Trike in Ormoc City

Particular	e-trike	Conventional tricycle	Incremental Cost/Benefits
Investment Cost	350,000.00	176,000.00	174,000.00
Gross Income (per day)	540.00	540.00	-
Operation & Maintenance Cost (per day)	100.00	350.00	(250.00)
Net income (per day)	440.00	190.00	250.00

Table 13. Statement of Incremental Cost and Benefits of e-Trike in Ormoc City

Year	Incremental Value	Discounted Value of Increment Cost/Benefits
0	174,000.00	(174,000.00)
1	53,750.00	47,991.07
2	53,750.00	42,849.17
3	53,750.00	38,258.19
4	53,750.00	34,159.10
5	53,750.00	30,499.19
6	53,750.00	27,231.42
7	53,750.00	24,313.77
8	53,750.00	21,708.72
9	53,750.00	19,382.79
10	53,750.00	17,306.06
Total Present Value of Incremental Benefits		**303,699.49**
Discounting Factor	12%	
Number of operating days a year	215	
Summary of Results:		
Return on Investment (ROI)	30.89%	
Profitability Index	1.75	
Net Present Worth (Php)	129,699.49	
Internal Rate of Return	14.59%	
Remarks:	Favorable	

The e-jeepney investment cost in Ormoc City has an incremental investment cost of Php 336,000.00 to the ordinary jeepney. However, this can obtain an incremental income of Php 4,590.00 per day as indicated in Table 14. In yearly calculation, the e-jeepney can realize an incremental income of Php 298,850.00 with a present value of 10-year inflows of about Php1.69 million discounted at 12% per annum (Table 15). The financial and economic indicators have shown very favorable results for e-jeepney with an ROI of 88.94% per annum, a profitability index ratio of 5.03:1 which means 5 times income will be generated from the initial investment cost, a positive NPV at 12% amounts to Php 1.35 million, and an IRR or yield of about 68.6% which is higher to 12% per annum hurdle rate.

Table 14. Financial and Economic Assessment of e-Jeepney in Ormoc City

Particular	e-jeepney	Conventional Jeepney	Incremental Cost/Benefits
Investment Cost	2,800,000.00	2,464,000.00	336,000.00
Gross Income (per day)	8,800.00	5,600.00	3,200.00
Operation & Maintenance Cost (per day)	400.00	1,790.00	(1,390.00)
Net income (per day)	8,400.00	3,810.00	4,590.00

Table 15. Statement of Incremental Cost and Benefits of e-Jeepney in Ormoc City

Year	Incremental Value	Discounted Value of Increment Cost/Benefits
0	336,000.00	(336,000.00)
1	298,850.00	266,830.36
2	298,850.00	238,241.39
3	298,850.00	212,715.53
4	298,850.00	189,924.58
5	298,850.00	169,575.52
6	298,850.00	151,406.71
7	298,850.00	135,184.56
8	298,850.00	120,700.50
9	298,850.00	107,768.31
10	298,850.00	96,221.70
Total Present Value of Incremental Benefits		**1,688,569.15**
Discounting Factor	12%	
Number of operating days a year	215	
Summary of Results:		
Return on Investment (ROI)	88.94%	
Profitability Index	5.03	
Net Present Worth	1,352,569.15	
Internal Rate of Return	68.56%	
Remarks :	Favorable	

C.3. Borongan City

In Borongan City, the operation of e-trike also has an incremental cost of investment of Php 174,000.00 and an incremental income of Php 157.28/day or Php 33,815.00 per year. It can be obtained with an ROI of 19.43%. The profitability index at 12% is greater than 1 (1.10:1). It has a net present value at 12% per annum of Php 191,063.42, and an IRR of 2.10% which is lower than the 12% hurdle rate. This implies that e-trike investment in Borongan City is not favorable (Tables 16 and 17).

Table 16. Financial and Economic Assessment of e-Trike in Borongan City

Particular	e-trike	Conventional tricycle	Incremental Cost/Benefits
Investment Cost	350,000.00	176,000.00	174,000.00
Gross Income (per day)	600.00	600.00	-
Operation & Maintenance Cost (per day)	137.72	295.00	(157.28)
Net income (per day)	462.28	305.00	157.28

Table 17. Statement of Incremental Cost and Benefits of e-Trike in Borongan City

Year	Incremental Value	Discounted Value of Increment Cost/Benefits
0	174,000.00	-174,000.00
1	33,815.20	30,192.14
2	33,815.20	26,957.27
3	33,815.20	24,068.99
4	33,815.20	21,490.17
5	33,815.20	19,187.65
6	33,815.20	17,131.83
7	33,815.20	15,296.28
8	33,815.20	13,657.39
9	33,815.20	12,194.10
10	33,815.20	10,887.59
Total Present Value of Incremental Benefits		191,063.42
Discounting Factor	12%/Annum	
Number of operating days a year	215 Days	
Summary of Results:		
Return on Investment (ROI)	19.43%	
Profitability Index	1.10	
Net Present Worth (Php)	17,063.42	
Internal Rate of Return	2.10%	
Remarks:	Not Favorable	

Like in Ormoc City, the e-jeepney operation performance in Borongan City also indicated very favorably in all financial and economic indicators. As shown in Table 18, e-jeepney has an incremental income of Php1,080.00 per day or Php 232,200.00 per year. The e-jeepney operation has obtained a present value of Php1.31 million from its incremental income for 10 years of operation (Table 19). It realized an ROI of 69.11%, PI @ 12% ratio of 3.9:1, positive NPV @ 12% of Php0.97 million, and an IRR of 50.66%. It indicates that e-jeepney operation in Borongan City has a better investment opportunity.

Table 18. Financial and Economic Assessment of e-Jeepney in Borongan City

Particular	e-jeepney	Conventional Jeepney	Incremental Cost/Benefits
Investment Cost	2,800,000.00	2,464,000.00	336,000.00
Gross Income (per day)	11,000.00	11,040.00	(40.00)
Operation & Maintenance Cost (per day)	1,860.00	2,980.00	(1,120.00)
Net income (per day)	9,140.00	8,060.00	1,080.00

Table 19. Statement of Incremental Cost and Benefits of e-Jeepney in Borongan City

Year	Incremental Value	Discounted Value of Increment Cost/Benefits
0	336,000.00	(336,000.00)
1	232,200.00	207,321.43
2	232,200.00	185,108.42
3	232,200.00	165,275.37
4	232,200.00	147,567.30
5	232,200.00	131,756.52
6	232,200.00	117,639.75
7	232,200.00	105,035.49
8	232,200.00	93,781.69
9	232,200.00	83,733.65
10	232,200.00	74,762.19
Total Present Value of Incremental Benefits		**1,311,981.79**
Discounting Factor	12%/Annum	
Number of operating days a year	215 Days	

Summary of Results:	
Return on Investment (ROI)	69.11%
Profitability Index	3.90
Net Present Worth	975,981.79
Internal Rate of Return	50.66%
Remarks	Favorable

In the case of the e-bus vs diesel bus in Borongan City, the e-bus has a greater incremental investment cost of Php16.48 million with an incremental margin of income of Php546.08 per day or Php 117,407.20 annually (Tables 20 and 21). From the projected 10 years' inflows of operation, it realizes a present value of Php 663,376.87 discounted at 12% per annum. The financial and economic indicators show that e-bus operation is unfavorable in Borongan City with an ROI of 0.71%, below 1, PI ratio (0.04:1), negative NPV at 12% of Php15.82 million, and a negative IRR of 39.06%.

Table 20. Financial and Economic Assessment of e-Bus in Borongan City

Particular	e-bus	diesel bus	Incremental Cost/Benefits
Investment Cost	25,300,000.00	8,815,000.00	16,485,000.00
Gross Income (per day)	24,000.00	24,000.00	-
Operation & Maintenance Cost (per day)	6,213.92	6,760.00	(546.08)
Net income (per day)	17,786.08	17,240.00	546.08

Table 21. Statement of Incremental Cost and Benefits of e-Bus in Borongan City

Year	Incremental Value	Discounted Value of Increment Cost/Benefits
0	16,485,000.00	(16,485,000.00)
1	117,407.20	104,827.86
2	117,407.20	93,596.30
3	117,407.20	83,568.13
4	117,407.20	74,614.40
5	117,407.20	66,620.00
6	117,407.20	59,482.14
7	117,407.20	53,109.05
8	117,407.20	47,418.80
9	117,407.20	42,338.21
10	117,407.20	37,801.98
Total Present Value of Incremental Benefits		**663,376.87**
Discounting Factor	12%	
Number of operating days a year	215	
Summary of Results:		
Return on Investment (ROI)	0.71%	
Profitability Index	0.04	
Net Present Worth	(15,821,623.13)	
Internal Rate of Return	-39.06%	
Remarks :	Not favorable	

D.3. Policy Dialogue on the Adoption of Electric Vehicles: The Case of the Cities of Cauayan, Ormoc and Borongan, Philippines

Order of Presentations for the Three Cities

Policy Development Issues and Directions on Electric Vehicle Adaption in the Philippines
Dir. Patrick T. Aquino
Director of the Energy Utilization Management Bureau (EUMB)- Department of Energy (DOE)

Dir. Patrick T. Aquino, Director of the Energy Utilization Management Bureau (EUMB) of the Department of Energy (DOE), presented the Role of the Local Government Units (LGUs) in the implementation of the Electric Vehicle Industry Development Act (EVIDA) and the CREVI. The goal of the shift towards electric vehicles is really to reduce reliance on imported fuel, thus increasing energy security in terms of EVs. The CREVI envisions having an EV industry locally with development and enough EVs used and EV charging stations (EVCS) in place. With this initiative of the government, the LGUs have a big role to play in its implementation and this includes the following:

a. Include green routes in their respective Local Public Transport Route Plans consistent with the National Transport Policy;
b. Issue Certificates of Inspection to the charging station;
c. Provide segregated lanes for LEVs in all major local and national roads in coordination with the Department of Public Works and Highways (DPWH);
d. Submit to the DOE not later than the 30th of January of every year the list of commercial use charging stations in their respective localities;
e. Issue permits for the construction or renovation of buildings or establishments pursuant to the guidelines promulgated by the DPWH to section 12 in EVIDA;
f. Ensure compliance of public and private buildings and establishments on the construction or installation of charging stations in the dedicated parking slots;
g. Issue necessary policies or legislations regulating the operation of EVS; and
h. Provide designated loading and unloading stations for EVs.

For this year 2024, the government through the DOE will be updating the numbers and targets for CREVI which would include the actual figures of EV targets with the Public Utility Vehicle (PUV) Modernization Program Targets in consideration of the Omnibus Franchise Guidelines, targets for the dedicated parking slots in buildings/establishments and the mandated EV fleet share. Also, at the end of the year, they are looking at the issuance of dedicated parking slots for buildings, facilities and establishments as well as the rules on the installation of parking slots and gasoline stations.

Analytical Study with Policy Brief on EV Adoption in Cities of the Philippines: The Case of the Cities of Cauayan, Borongan and Ormoc
Dr. Orlando F. Balderama
Isabela State University/UNESCAP Focal Person

Dr. Orlando F. Balderama presented the results of the analytical study on the adoption of EVs as well as the recommendations and policy pathways that could be adopted in the City of Cauayan. Based on the comparative analysis, between the conventional tricycle and the e-trike, using the e-trike will give the driver a higher income than that of the conventional tricycle, this difference is attributed to the operating cost which is relatively higher for a conventional

tricycle than that of an e-trike. In terms of the comparative analysis using a conventional jeepney and an e-jeepney, the net income using the e-jeepney is higher than that of the conventional jeepney. For the diesel-powered UV and an e-vehicle, the net income is slightly higher for the e-vehicle than that of the diesel-powered UV. With this, it is concluded that EVs are economically feasible. Moreover, EVs will contribute significantly to the attainment of the Paris Agreement and bring long-term benefits to the local environment and economy. For the policy pathways, LGU-Cauayan City to pursue a partnership with DOST-CSU e-mobility center and local fabricators for technology transfer and sustainable adoption of EVs; to partner with local R&D institutions for continuing research and policy studies in improving technology and utilization uptake of e-vehicles; and to craft and approve the e-vehicle adoption program.

Open Forum

Issues and Concerns	Response
Cauayan City	
How can other cities like the General Santos City be part of the ESCAP's program on e-vehicles?	Just send a request letter to ESCAP.
Where to purchase about 60 e-trikes?	Try Xiangsi or other networks then a Technology Licensing Agreement (TLA) can be made. Also, with the assistance of the DOST, a forum can be conducted. If there is an integrated metal fabricator in the area (General Santos City), a TLA may be signed with the President, LGU and CSU and the fabrication will be done in the area to reduce shipping fee cost.
The environmental aspect on the disposal of the batteries should also be part of the roadmap because fossil fuels are used to produce the batteries.	This is a good suggestion that we should include in the roadmap that is being developed. Additionally, the recycling and reuse of batteries as well as how to dispose of them properly are already part of the roadmap in the R&D sector. In relation to the manufacturing side, the DOST is now partnering with the private sector through motolite (battery manufacturer) if they could help the DOST to put up the battery recycling facility. The feasibility study is ongoing to ensure that there is a viability in the market, how it will be done and to determine how much it will cost and how it will be able to help the environment. The batteries used for these EVs are lithium ions, which are more environment-friendly compared to lead acid batteries.
Ormoc City	
How much is the cost of an individual unit?	The cost of 1 unit EV is P600,000.00 with a capacity of 6 passengers and 1 driver. But once the technology is transferred to the technology adopter, it is expected that the cost will be lesser.

Issues and Concerns	Response
How long is the travel time or the kilometer distance for each fully charged EV?	The distance for each fully charged EV is 80 km.
Are there any available parts (for maintenance) if EVs are adopted?	The list of suppliers will be provided. Also, for the continuity of the program, CSU is tying up with all State Universities and Colleges in the Philippines to provide the necessary training for maintaining the vehicle. So, for Ormoc City, CSU can link with the Visayas State University to provide the necessary support services for the maintenance of EVs.
What is the lifespan of the EV battery?	All battery manufacturers consider the battery shelf-life, so the 5 years utilization of battery is recommended.
Is the Return on Investment included in the study?	Yes, the 15 and 20-year life cycles were computed and the results revealed that the investments would be recouped. For the loan system, there may not be a high interest that will be awarded to the borrowers since the government is trying to move towards the popularization of EVs.
Does the DOE have a business model available that can be adopted in crafting the EV adoption program and put in the action plans of LGUs for the EV program?	What our colleagues from the city government of Ormoc can do to help our push for electric vehicles in a commercially viable way is that maybe they can adopt dedicated green routes provided under EVIDA that are only pliable or can be used by those who are using electric tricycles. Another is instead of putting a premium on electric tricycle fares, maybe Ormoc City can do the alternative so that more people will use e-trikes, such that the city will make it a little bit more expensive for those who choose not to use electric tricycles in terms of the fare matrix. Part of the cost of e-trikes will be availed off through concessional financing, maybe through the government financial institutions, landbank or DBP as part of their energy transition or green or clean mechanisms so that the payment terms and the interest rates will be substantially lower so that a portion of the costs associated to the purchase of the EVs will also be lower.
How much is the loanable amount of EVs?	It depends on the number of units. But based on the EVIDA, LBP, and DBP are obliged to provide concessional loans, so it will slightly be lower than the commercial rate.
Are EV parts available anywhere? If not, how long does it take to wait for the parts to be available?	The DOE is willing to sit down with the City of Ormoc to make sure that the choices available for the units that you might be considering would have the service centers and would have the necessary

Issues and Concerns	Response
	support there.
With regards to technology transfer of the development or the fabrication of EVs, how much would be the minimum investment if an investor would like to adopt this technology development?	That is one way of spreading the technology and if there is a possible investor, there are those people who are already engaged in any vehicle production activity so that investment would not be that big anymore. They should have existing facilities and are already engaged in the fabrication of vehicles so that it won't cost them to have a new system of developing the e-trike and the capital investment will be lower. The budget requirement depends on how many units you are going to produce. For the project of CSU, they are transferring the technology through the strategy of DOST which is the TLA which can be done easily through proper coordination with the concerned organization. If there is a metal industry promotion and see who is willing to start the project through the promotion of EVs, CSU is not limiting the promotion of EVs out of the products only of CSU. If we were to invest, fairly Php 500,000.00 will produce at least 5 e-trikes.
Is there any specific activity that the government is willing to undertake to accelerate the uptake of EVs and make the targets?	A specific intervention that the government will be doing to increase further the number of EVs, particularly battery EVs, is that DOE is working on the temporary suspension of import tariffs to include two and three-wheelers. Last year, the President issued an executive order temporarily suspending the import tariff for pure battery EVs (four-wheelers) and more. This year, the DOE is pushing for the expansion to cover all types of vehicles for the same period which is five years. This will necessarily result in a reduction of the cost, particularly of battery EVs anywhere from 5-30% (import tariff that is imposed if it is imported). This will be a temporary measure for five years so that we will be able to support and provide choices to the public in terms of the EV stocks that are in the country. Incidentally, since the import tariff suspension, the government has more choices in terms of EVs for the public from virtually having just a dozen, there are now close to 70 types of battery EVs commercially available. Finally, on the government side, it is poised to provide the mechanism to allow for the whole of the government to purchase the specific numbers indicated in the CREVI mandate so that they will have EVs starting 2025. So, the government moving forward will be purchasing a portion of their vehicle acquisitions as EVs.
There have been some discussions in the past about getting rid of jeepneys and banning them because of the	With regards to the proposed EV to be included in the PUV modernization program, the Philippine government is encouraging the manufacturers of

Issues and Concerns	Response
huge amount of pollution that is coming from jeepneys, and the engines are very old. Is there an opportunity to replace electric jeepneys or convert them to EV?	these EVs. We do not impose the choice of the operators on the type of vehicles they will use but the government is encouraging the use of EVs.
How does the program on the adoption of EVs be of help in compliance with the PUV modernization program?	The eMRDC is still waiting on the actual figures from the Department of Transportation (DOTr) regarding the mandated numbers for the switch to EVs. The EVIDA indicates that the public utility vehicle transport sector is a covered sector that must comply with the 5% requirement under the law, which has been increased to 10%. They will provide the materials at the cost per kilometer. Studies already show, as indicated in the news, that it's cheaper to run EVs. This information will be provided to the city government so that it can be shared with the public. It is recommended to the City Government of Ormoc because it hosts many renewable energy facilities. Switching to EVs will significantly contribute to the city governments and Ormoc residents' energy sustainability and transition efforts. They want to help the City Government and the people of Ormoc realize their dreams and aspirations regarding energy sustainability, security, and independence.
EVs require a charging station which also requires a power supply. Since our goal is for sustainable energy, it is advisable that the power supply of this charging station should come from renewable energy. For DOE, I just want to ask what specific DOE policy or IRR is where the establishment of charging stations is stipulated so that LEYECO V will be guided on that policy to conform with the output of this endeavor?	The particular portion you are referring to on the smart grid, particularly on EV charging stations, has been superseded by the EV charging station provider accreditation and EV charging station registration guidelines. We are working with the Department of Interior and Local government for the issuance of a memorandum circular reminding our LGU colleagues that the installation of charging stations does not change the nature of the location. If it is a parking area, then it would still be a parking area. If the existing permit of a certain establishment is still valid, it can still be used, it does not need a new permit. Regarding the requirements of charging stations to be fully sourcing their powers whether onsite through attribution from renewable energy, that will be a program that will be coming out, the draft is being circulated internally in DOE and we are hopeful to do public consultation on this.
Is the establishment of the charging station included in the study to comply so that the charging station will be coming from a sustainable and green power supply?	We can use an alternative source of energy for charging EVs. It can be using alternative sources through the use of solar cells and at the same time can be linked through the electric power provider.

Issues and Concerns	Response
Borongan City	
Is there any program or policy by the national government where the LGU can buy e-buses and the taxes will be waived by the BIR?	In terms of purchasing electric vehicles, please explore with the national government about discounts and the existing policy or programs.
If the planned 'Libreng Sakay' (free ride) program by the LGU is implemented, will the LGU be given an incentive like zero tax? The LGU is requesting assistance from the LTFRB and LTO on this matter.	If the LGU provides transport service to constituents along the national highway at a subsidized rate, the LTFRB would require the LGU to secure a franchise, as it is a local government using e-buses in this instance. If free fare is implemented and these e-buses serve as shuttles for LGU employees, the LGU doesn't need a franchise since this is not for business. However, if it is for the public with a fee, even a minimal one, an independent operator should apply to cater to the constituents who will ride the bus, as this will compete with our existing operators who are franchise holders. Therefore, the LGU is advised to write an official letter to the head offices of the LTFRB and LTO to request a franchise for the e-bus for the 'Libreng Sakay' program, and these offices are willing to assist the LGU.
As hydro and renewable energy capacities increase in the city area, will the LGU plan to build these projects under the administration of the city, or will a private developer handle this and connect it to the national grid?	The LGU intends to build this project in partnership with the private sector, but the city government is concerned about which company will set it up. This will not be given for free to the private investor, as the LGU will be a co-owner of the project. We aim to return every earning from this partnership back to the host barangay in the form of a subsidized electric grid. This initiative is designed to encourage people not to cut trees, as trees are needed for hydro projects and serve as protection against typhoons. The community needs a cheaper electricity grid.

E. CHALLENGES AND OPPORTUNITIES

Based on the policy dialogues conducted for the three cities - Cauayan, Ormoc, and Borongan, the following are the challenges and opportunities that were discussed regarding the adoption of EVs.

E.1. CHALLENGES

- High investment costs of EVs. The initial cost of electric vehicles (EVs) is higher compared to traditional gas-powered vehicles. This is the major factor that hinders vehicle operators from adopting EVs.
- The availability of charging stations and the charging time.
- The availability of spare parts in the market.
- Limited travel range and the uncertainty of running out of battery power while driving.
- Limited awareness and acceptance among the public regarding the benefits and usage of EVs pose a challenge. Many consumers are still unfamiliar with EV technology and its advantages.

E.2. OPPORTUNITIES

- EVs are more energy efficient and may require lower operating and maintenance costs.
- EVs do not use fuel to operate and do not emit greenhouse gases, thus, saving the environment.
- In purchasing EVs, the government through government financial institutions like the LandBank of the Philippines and the Development Bank of the Philippines provide concessional loans where the interest is lower compared to their regular loans.
- In the establishment of charging stations, alternative source of power which is renewable energy like solar and hydro can be used, thus, reducing air pollution and dependence on imported fuels.
- Higher net income for EV operators compared to conventional vehicles
- Local universities and research centers are advancing EV technology, offering considerable opportunities. Programs like the Electromobility Research and Development Center (eMRDC) are leading the way in creating EV prototypes and conversion technologies. These innovations can be scaled and commercialized, allowing local businesses to enter the growing EV market.
- Training on the operation and maintenance of EVs from technology providers and academic institutions.

F. CONCLUSION, RECOMMENDATION AND POLICY PATHWAYS

The transportation industry in the Philippines has a growing demand for fossil fuels, a factor that significantly contributes to climate change and global warming. One sustainable way to lessen the negative consequences of climate change is through the adoption of electric vehicles. Thus, the study on EV development in the cities of Cauayan, Borongan, and Ormoc in the Philippines was conducted.

Based on this study, the following conclusions, recommendations, and policy pathways were identified.

F.1. CONCLUSION

- EVs like e-trikes and e-jeepneys have higher net incomes due to lower operating costs. However, e-buses have a high initial cost, affecting short-term financial appeal.
- EVs reduce carbon emissions and improve air quality, aligning with the Paris Agreement goals and enhancing energy security.
- Successful EV adoption needs strong support from local governments, partnerships with R&D institutions, and the development of charging stations and battery recycling facilities.

F.2. RECOMMENDATION

- LGUs should collaborate with national agencies, R&D institutions, and private sector stakeholders to facilitate technology transfer and enhance the local capacity for EV production and maintenance.
- Develop and implement plans for establishing EV charging stations and battery recycling facilities. Prioritize areas with high potential for EV adoption based on current transport routes and community needs.
- Launch educational campaigns to inform the public about the benefits of EVs, addressing concerns related to charging times and overall cost savings
- Invest in ongoing R&D to improve EV technology, including battery efficiency and vehicle performance, and to explore new business models for EV integration in public transport.
- The LGU should pursue a partnership with DOST-CSU e-mobility center and local fabricators for technology transfer and sustainable adoption of e-vehicles.
- The LGU should craft and approve the e-vehicle adoption program.

F.3. POLICY PATHWAYS

- Develop and enforce regulations for the construction and operation of EV charging stations. Ensure compliance with safety and environmental standards, and streamline the permitting process for new EV infrastructure.
- Develop a comprehensive roadmap for EV adoption that includes short-term and long-term goals, specific action plans, and measurable targets. This roadmap should address both the technical and social aspects of the transition to EVs.

G. REFERENCES

Orpilla, M. B., Ibanez, A. G., Dumlao, F. S., & Tolentino, H. B. (2023). Comparative Study between Conventional and Converted Electric Tricycle. Philippine Journal of Science, 152(3), 1235–1244. https://doi.org/10.2139/ssrn.4207357

Department of Energy, Comprehensive Roadmap for the Electric Vehicle Industry, 2023. https://www.doe.gov.ph/sites/default/files/pdf/energy_efficiency/CREVI%20as%20of%2005-04-2023.pdf

Electromobility Research and Development Center in Region 2

E-trikes in Cauayan City: Smarter Mobility for Smarter City, Charge in Minute (CharM Project)

ANNEX A - PHOTOGRAPHS

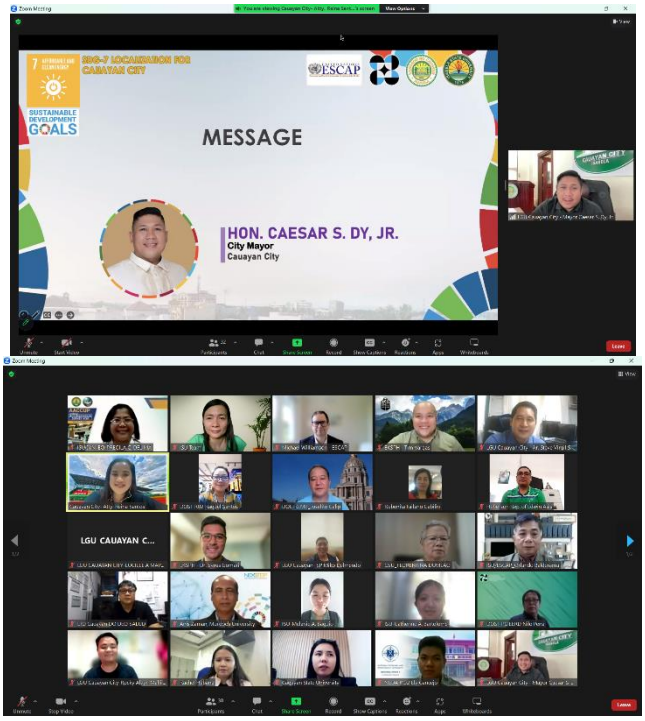

Figure 1. The onsite and online participants joining the Stakeholders Workshop and Consultation Meeting: Inception Meeting on E-Vehicle Project in Cauayan City

Figure 2. The onsite and online participants joining the Stakeholders Workshop and Consultation Meeting: Inception Meeting on E-Vehicle Project in Borongan City.

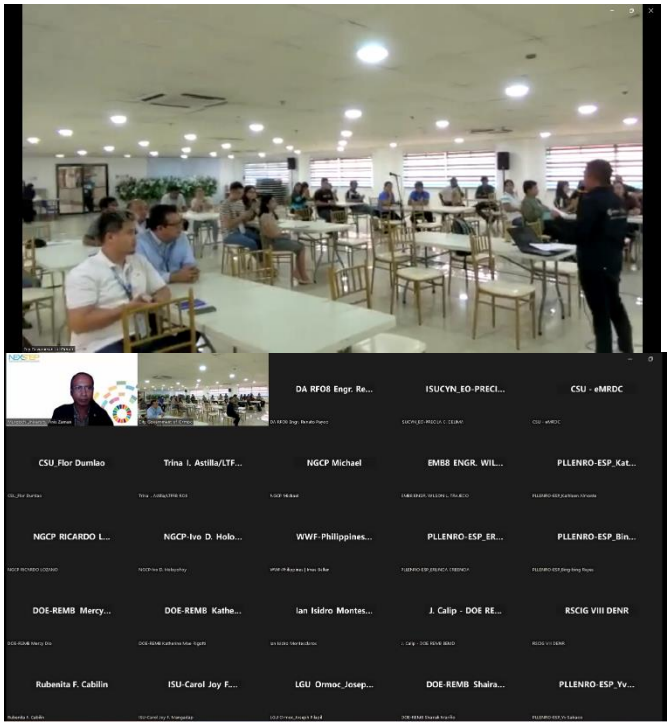

Figure 3. The online and onsite participants during the Stakeholders Workshop and Consultation Meeting: Inception Meeting on E-Vehicle Project in Ormoc City.

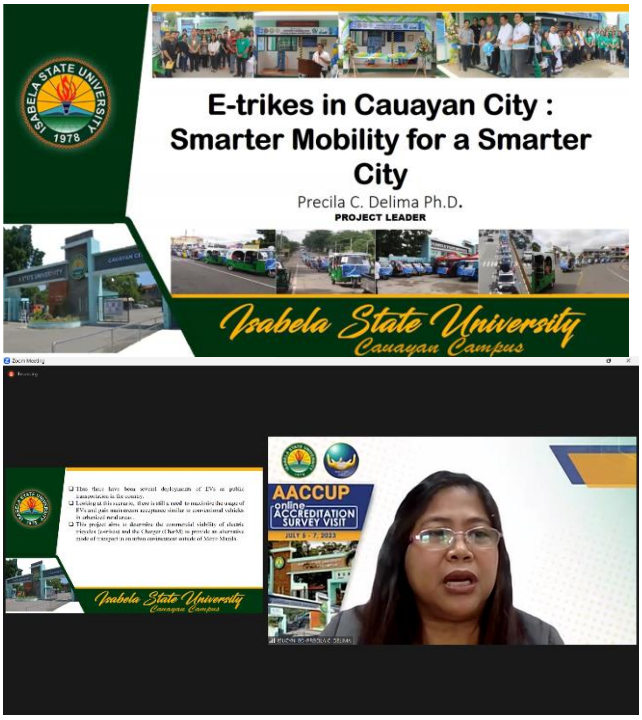

Figure 4. Dr. Precila C. Delima presenting during the Stakeholders Workshop and Consultation Meeting: Inception Meeting On E-Vehicle Project via online platform.

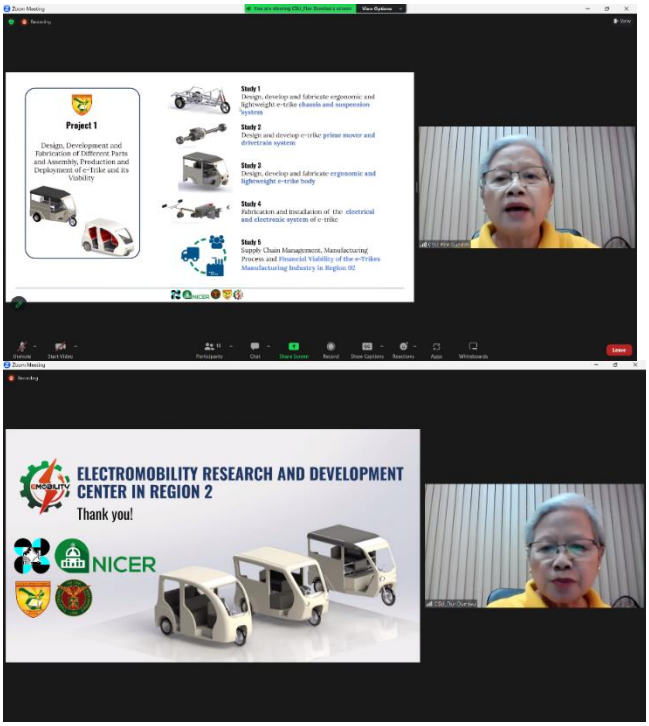

Figure 5. Dr. Florentina Dumlao presenting during the Stakeholders Workshop and Consultation Meeting: Inception Meeting On E-Vehicle Project via online platform.

Figure 6. Dr. Orlando Balderama presenting the results of the Analysis of EV adoption in Ormoc City during the Policy Dialogue on February 16, 2024, via online platform.

Figure 7. Director Patrick Aquino of the DOE during his presentation on the Roles of the LGUs in the implementation of the EVIDA and CREVI during the Policy Dialogue on the Adoption of Electric Vehicles: The Case of the City of Ormoc, Philippines on February 16, 2024.

Figure 8. The Online and Onsite participants during the Policy Dialogue on the Adoption of Electric Vehicles: The Case of the City of Ormoc, Philippines on February 16, 2024.

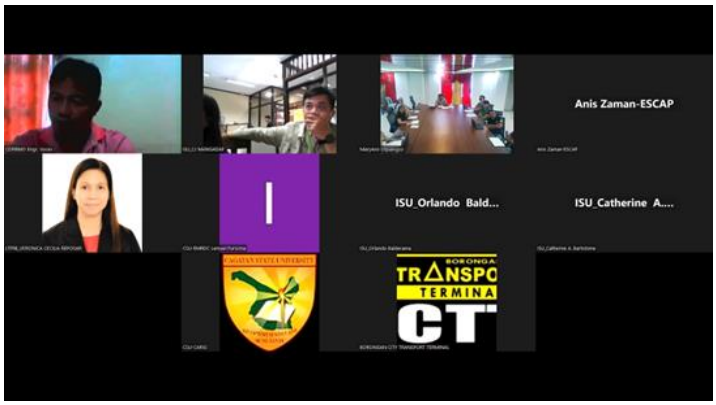

Figure 9. The participants during the Policy Dialogue on the Adoption of Electric Vehicles: The Case of the City of Borongan, Philippines on March 6, 2024, via online platform.

Figure 10. The participants during the Policy Dialogue on the Adoption of Electric Vehicles: The Case of the City of Cauayan, Philippines on April 12, 2024.

ANNEX B – ATTENDANCE

Table 22. List of Participants during the Inception Workshop - Cauayan City, 2023.

Agency	Name of Participants
Academe	
Cagayan State University,	Dr. Florentina Dumlao
Isabela State University (ISU) - Cauayan Campus	Dr. Precila Delima
ISU Echague Campus	Engr. Melanie Baguio
Government Agencies	
Department of Energy – Renewable Energy Management Bureau (DOE-REMB)	Mr. Joselito Calip Ms. Rubenita Cabilin Ms. Shairah Mariño
Department of Science & Technology -Philippine Council for Industry, Energy and Emerging Technology Research and Development (DOST-PCIEERD)	Dr. Nonilo Peña Dr. Syrus Gomari Ms. Rachel Habana
DOST – Region 02	Ms. Raquel Santos
Land Transportation Office	
National Economic Development Authority – Region 02	Mr. Ely Cancejo Mr. Giovani I. Maguddayao
Private Sector	
Electric Kick Scooter Philippines	Mr. Tim Vargas Dr. Syrus Gomari
Organizers	
UN-ESCAP	Michael Williamson Anis Zaman
Cauayan City LGU	Mayor Caesar Dy, Jr. Atty. Reina Santos SP Micko Delmendo Ms. Steve Virgil Sarabia Ms. Lucille Mapote Mr. Rocky Alvyn Mallillin Ms. Mitzi Gabriel Ms. Rachel Habana
Isabela State University	Dr. Orlando Balderama Engr. Carol Joy Mangadap Engr. Catherine Bartolome

Table 23. List of Participants during the Inception Workshop - Borongan City, 2023.

Agency	Name of Participants	Remarks
Academe		
Cagayan State University	Florentina Dumlao	Online
Isabela State University (ISU) - Cauayan Campus	Dr. Precila Delima	Online
Government Agencies		
Department of Energy	Mr. Jun Getalado (UEMB) Mr. Dante Castillo (UEMB) Mr. M.D. Dio (Renewable Energy Management Bureau-REMB) Ms. Shairah Mariño (REMB) Mr. Carlo Basbas (REMB) Ms. Katherine Mae Regote (REMB) Mr. Peter Sablay	Online Online Online Online Online Online Online
DOST – Region 08	Mr. Armando Amasco, Jr. Mr. Eric Baustista	Online Online
Land Transportation Office		
National Economic Development Authority – Region 02	Ms. Evangeline Paran Ms. Josefina Ballesteros	Online Online
Borongan City LGU	Mr. Napoleon Bebita Mr. J. Acla Ms. Amanthea Dala Mr. Dionisio Pabo Ms. Sheena Joy Beros Zaira Casillano	Onsite Onsite Onsite Onsite Onsite Onsite
Private Sector		
Transport Group	Mr. Romualdo Arre Mr. Joseph Cadada	Onsite Onsite
Organizers		
UN-ESCAP	Michael Williamson Anis Zaman	Online Online
Borongan City LGU	Mayor Jose Ivan Dayan C. Agda Engr. Maria Anne Lopez Engr. Diane Apura SP Sergio Gilbert Escotu III	Onsite Onsite Onsite Onsite
Isabela State University	Dr. Orlando Balderama Engr. Carol Joy Mangadap Engr. Catherine Bartolome Ms. Judith Faith Balderama	Onsite Onsite Onsite Onsite

Table 24. List of Participants during the Inception Workshop - Ormoc City, 2023.

Agency	Name of Participants	Remarks
Academe		
Cagayan State University (CSU)	Florentina Dumlao	Online
CSU Electromobility Research & Development Center	Representative	Online
Isabela State University (ISU) - Cauayan Campus	Dr. Precila Delima	Online
Visayas State University	Mr. Nilo Leorna	Onsite
Government Agencies		
Department of Energy – Renewable Energy Management Bureau – Region 08	Ms. Mercy Dio Ms. Katherine Mae Rigotti Mr. J. Calip Ms. Sharah Mariño	Online Online Online Online
Department of Environment and Natural Resources (DENR) – Environmental Management Bureau – Region 08 DENR - Regional Strategic Communication and Initiatives Group	Mr. Wilson Trajeco Representative	Online Online
Department of Agriculture – Region 08	Engr. Renato Payod	Online
Department of Science & Technology – Region 08	Mr. John Ocaña Mr. Mardy Monten	Onsite Onsite
Land Transportation Franchising and Regulatory Board – Region 08	Ms. Trina I. Astrilla	Online
City Government of Ormoc	Atty. Jasper Lucero (city Councilor Mr. Niño Paolo Roto (SP Marcos Office) Mr. Joshua Richardum (SP Marcos Office) Ms. Joramay Morales (CPDO) Mr. Allan Nobmia (TESDC) Ms. Jovita Ang (CSWD) Mr. Albert Rojas (CEO) Mr. Georgin Rojas, Jr. (CEO) Mr. Coloy Tolibao (CDRRMO) Mr. Louir Martires (CDRRMO) Ms. Jocelyn Fril (ENRO) Ms. Mary Joy Dayan (ENRO) Ms. Everth Acaso, Jr. (OBO) Mr. Victor Hugo III (BPLO) Ms. Arlene Magalona (CBO) Mr. Allan Guerra (CBO) Ms. Grace Capuyan (TDFRO) Ms. Christy Valerie Palaco (ORCHAM) Mr. Barnsby Cagang (TEAM) Rubenita Cabilin	Onsite Online
Private Sector		
Energy Development Cooperative	Mr. Erwin Magallanes	Onsite

Agency	Name of Participants	Remarks
Leyte Electric Cooperative V	Mr. Arnel L. Banzon Ms. Elvira M. Baluyo Mr. Cristobal Dechave	Onsite Onsite Onsite
National Grid Corporation of the Philippines	Mr. Ricardo Lozano Mr. Ivo Holoyohoy Mr. Michael	Online Online Online
World Wildlife Fund – Philippines	Ms. Imee Bellen	Online
Philippine League of Local Environment and Natural Resources Officers (PLLENRO) - ESP	Ms. Kathleen Almonte Ms. Erlinda Creencia Ms. Bingbing Reyes Ms. Yv Sabado	Online Online Online Online
Organizers		
UN-ESCAP	Anis Zaman	Online
City Government of Ormoc	Mr. Joseph Pilapil (CPDO)	Onsite
Isabela State University	Dr. Orlando Balderama Engr. Carol Joy Mangadap Engr. Catherine Bartolome Ms. Judith Faith Balderama	Onsite Onsite Onsite Onsite

Table 25. List of Participants during the Policy Dialogue on the Adoption of Electric Vehicles: The Case of Ormoc City, 2024.

There was a total of 34 participants during the policy dialogue where 13 participated through the online platform and 21 through on-site.

Agency	Name of Participants	Remarks
Department of Energy-Energy Utilization Management Bureau (DOE-EUMB)	Dir. Patrick T. Aquino Annie Ornillo Oliver Besamito	Online Online Online
Land Transportation Franchising and Regulatory Board (LTFRB)	Veronica Cecilia Repusar	Online
Department of Science & Technology (DOST)	John Glen Opeña	Online
National Economic Development Authority – Region 8 (NEDA 8)	Josefina Ballesteros Jay-ar Ragub	Online Online
Cagayan State University	Florentina Dumlao	Online
United Nations - Economic and Social Commission for Asia and the Pacific	Michael Williamson Anis Zaman	Online Online
Isabela State University	Orlando Balderama Catherine Bartolome Carol Joy F. Mangadap	Online Online Online
Leyte Electric Cooperative V (LEYECO V)	Arnel Bansan Michael Geñares	Onsite Onsite
Energy Development Cooperative	Albenia Porshia Co	Onsite
Ormoc Metrocab Operator Association	John Rey Cabonilas William Mendoza	Onsite Onsite
United Overa Transport Cooperative	Romulo Gacuyong	Onsite
Sabangba O. Valencia Transport Cooperative	Roel Locanias	Onsite
Ormoc Transport Cooperative	Nicolas Oliveros	Onsite
Transportation Development and Franchising Office	Dennis Paca	Onsite
City Environment and Natural Resources Office	Jonalyn Cuevas Jocelyn Quiel	Onsite Onsite
City Cooperative Development Office	Romeo Dela Cruz	Onsite
Information Technology Division	Mel Cedequia	Onsite
City Administration Office	Dianne Aparis	Onsite
Business Permit & Licensing Office	Sheryl Gallo Anthony Orayle	Onsite Onsite
Office of SP Lalaine Marcos	Joshua Richardson	Onsite
Office of Atty. Nolito Quilang	Mary Grace Lakandula	Onsite
City Mayor's Office - Media	Joana Grace Obeñas	Onsite
City Planning Office	Raoul Cam Joramay Morales	Onsite Onsite
UN-ESCAP	Anis Zaman	Online

Table 26. List of Participants during the Policy Dialogue on the Adoption of Electric Vehicles: The Case of Borongan City, 2024.

Agency	Name of Participants	Remarks
Cagayan State University	Lemuel Purisima Dr. Florentina Dumlao	Online Online
Isabela State University	Dr. Orlando Balderama Engr. Carol Joy Mangadap Engr. Catherine Bartolome	Online Online Online
Land Transportation Franchising and Regulatory Board (LTFRB)	Veronica Reposa	Online
National Economic Development Authority – Region 8 (NEDA 8)	Josefina Ballesteros	Online
City Planning Office	Engr. Maria Anne Lopez	Onsite
City Disaster Risk Reduction Management Office	Engr. Loco	Online
Office of the SPM	Melchor Anago	Online
Mayor's Office	Mayor Jose Ivan Dayan C. Agda Engr. Diane Apura SP Sergio Gilbert Escotu III	Onsite Onsite Onsite
Borongan Transport Terminal		Online
UN-ESCAP	Anis Zaman	Online

Table 27. List of Participants during the Policy Dialogue on the Adoption of Electric Vehicles: The Case of Cauayan City, 2024.

Agency	Name of Participants	Remarks
EmRDC-Cagayan State University	Lemuel Purisima Dr. Florentina Dumlao	Onsite Onsite
Cebu PSTO/DOST 7	Adrian D. Cruz	Onsite
Pangasinan State University	Harry Alan P. Errasquin	Onsite
DOST Region I	Sheeren Joy Engada	Onsite
LGU Batac	Aliana Ranga	Onsite
DOST IX	Jeyzel P. Aparri Kristine Mae R. Sarita	Onsite Onsite
DOST Negros Oriental PSTO	Joel O. Legaspi	Onsite
DOST I	Bernadine Suniega Brian Rasco	Onsite Onsite
LGU Bactotan, Launion	Miguel Riddon Velmonte	Onsite
DOST-NCR	Carmel Ericka L. Mammag Jennylle R. Escarcha Claudeta Bianca	Onsite Onsite Onsite
LGU General Santos	Dominador Lagare	Onsite
DOST XII	Babai K. Tagatican Giscelle Eve O. Siladan	Onsite Onsite
DOST-PCIEERD	Justine Ryan Rigates Rachel R. Habana	Onsite Onsite
DOST IV-A	Patrice Isaiah Obamara	Onsite
LGU Cauayan	Kayla Alexander Dy-Trinidad Sharel V. Ramos Modesto B. Dumrique	Onsite Onsite Onsite
DOST II	John Benedic De Asis	Onsite
DOST-CAR	Carluz R. Bautista Karl Jan Martinez Jocelyn Robles Agustina Upang	Onsite Onsite Onsite Onsite
DOST III	Jerwin Viason Lalaine Peña	Onsite Onsite
LGU Mandaon Masbate	Bernard Kristine Salve Kho	Onsite Onsite
DOST XI	Elvie Mae Udlidur	Onsite
Isabela State University	Orlando F Balderama Precila Delima Catherine Bartolome Carol Joy Mangadap	Onsite Onsite Onsite Onsite
UN-ESCAP	Anis Zaman	Online

ANNEX C – ADDITIONAL DATA

Table 28. Cost-benefit analysis of electric vehicles: total cost of ownership aspect. (Source: DOE, CREVI, 2023)

- E-tricycles (e-TC)

Cost Item	e-TC	Conventional TC	Savings
Investment	350,000.00	176,000.00	-174,000.00
Energy	1,206,109.56	2,017,254.29	811,144.73
Financing Cost	49,455.33	21,333.67	-28,121.66
Reg. Maintenance	146,700.65	273,969.34	127,268.69
Midlife Rebuilding	-	-	-
Batt Rep	108,000.00	-	-108,000.00
Salvage Value	-24,700.00	-8,800.00	15,900.00
Financial NPV	1,835,565.54	2,479,757.30	644,191.76
Health	23,314.73	93,787.50	70,472.77
GHG	13,474.15	35,981.05	22,506.90
BOP	14,065.35	111,232.13	97,166.77
Taxes	-220,874.24	-444,268.32	-223,394.08
Economic NPV	1,665,545.55	2,276,489.66	610,944.12

Notes: e-TC=electric tricycle, Con TC=conventional tricycle, Reg. Maint=regular maintenance, Batt Rep=battery repair, GHG=greenhouse gas, BOP=balance of payments, NPV=net present value

- E-jeepney (e-JP)

Cost Item	e-JP	Conventional jeepney	Savings
Investment	2,800,000.00	2,464,000.00	-336,000.00
Energy	6,541,967.30	10,436,044.25	3,894,076.95
Financing Cost	599,593.04	523,281.20	-76,311.84
Reg. Maintenance	1,929,274.39	3,122,597.54	1,193,323.15
Midlife Rebuilding	68,872.94	90,912.28	22,039.34
Batt Rep	1,211,800.00	-	-1,211,800.00
Salvage Value	-202,380.00	-123,200.00	79,180.00
Financial NPV	12,949,127.67	16,513,635.27	3,564,507.59
Health	145,095.95	668,096.24	523,000.28
GHG	86,384.95	256,311.41	169,926.45
BOP	79,117.61	695,200.79	616,083.18
Taxes	-1,475,023.47	-2,901,009.22	-1,425,985.75
Economic NPV	11,784,702.73	15,232,234.49	3,447,531.76

Notes: Reg. Maint=regular maintenance, Batt Rep=battery repair, GHG=greenhouse gas, BOP=balance of payments, NPV=net present value

- E-bus

Cost Item	Battery Electric Bus (BEB)	Diesel Bus	Savings
Investment	25,300,000.00	8,815,000.00	-16,485,000.00
Energy	47,907,236.72	69,573,628.34	21,666,391.62
Financing Cost	6,347,373.38	1,816,921.46	-4,530,451.92
Reg. Maintenance	3,215,457.32	5,204,329.23	1,988,871.91
Midlife Rebuilding	622,316.18	325,240.14	-297,076.03
Batt Rep	-	-	-
Salvage Value	-1,265,000.00	-440,750.00	824,250.00
Financial NPV	82,127,383.60	85,294,369.18	3,166,985.58
Health	1,381,866.22	4,453,974.90	3,072,108.68
GHG	822,713.85	1,708,742.73	886,028.87
BOP	753,501.09	4,634,671.96	3,881,170.87
Taxes	-9,703,948.68	-16,519,401.91	-6,815,453.23
Economic NPV	75,381,516.08	79,572,356.86	4,190,840.78

Notes: BEB=battery electric bus, Reg. Maint=regular maintenance, Batt Rep=battery repair, GHG=greenhouse gas, BOP=balance of payments, NPV=net present value. Assumption