COMPREHENSIVE ROADMAP FOR THE ELECTRIC VEHICLE INDUSTRY

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List of Acronyms

ADB	Asian Development Bank
BCM	Battery cell manufacturing
BEV	Battery electric vehicle
BSS	Battery swapping station
BOC	Bureau of Customs
BFP	Bureau of Fire Protection
BIR	Bureau of Internal Revenue
BAU	Business-as-usual
CO_2	Carbon dioxide
COC	Certificate of Conformance
CharM	Charging in Minutes
CES	Clean energy scenario
CCC	Climate Change Commission
CHVSR	Committee on Harmonization of Vehicle Standards and Regulation
CKD	Completely knocked down
CARS	Comprehensive Automotive Resurgence Strategy
CREVI	Comprehensive Roadmap for the Electric Vehicle Industry
CREATE	Corporate Recovery and Tax Incentives for Enterprises
CBA	Cost-benefit analysis
DC	Department Circular
DBM	Department of Budget Management
DOE	Department of Energy
DENR	Department of Environment and Natural Resources
DOF	Department of Finance
DICT	Department of Information and Communication Technology
DPWH	Department of Public Works and Highways
DOST	Department of Science and Technology
DILG	Department of the Interior and Local Government
DTI	Department of Trade and Industry
DOTr	Department of Transportation
MIRDC	DOST-Metals Industry Research and Development Center
PCIEERD	DOST-Philippine Council for Industry, Energy and Emerging Technology Research and Development
LTFRB	DOTr-Land Transportation Franchising and Regulatory Board
LTO	DOTr-Land Transportation Office
BOI	DTI-Board of Investment
BPS	DTI-Bureau of Philippine Standards
e-Bus	Electric Bus
e-JP	Electric jeepney
e-MC	Electric motorcycle
e-SUV	Electric sports utility vehicle
e-TC	Electric tricycle
e-UV	Electric utility vehicle
EV	Electric vehicle
EVAP	Electric Vehicle Association of the Philippines
EVCS	Electric vehicle charging station
EVIDA	Electric Vehicle Industry Development Act
EVIS	Electric Vehicle Incentive Strategy
EVSE	Electric vehicle supply equipment
EE	Electrical Engineer

ECE	Electronics and Communication Engineer
ERC	Energy Regulatory Commission
ED	Enhanced Deductions
EO	Executive Order
GW	Gigawatt
GEF	Global Environment Facility
GHG	Greenhouse gas emissions
HPAL	High-pressure acid leaching
HEV	Hybrid electric vehicle
IRR	Implementing Rules and Regulations
ITH	Income tax holiday
IEC Campaign	Information, Education and Communication Campaign
IC	Integrated Circuit
ICE	Internal combustion engine
ICEV	Internal combustion engine vehicle
IEC	International Electrotechnical Commission
IEA	International Energy Agency
ISO	International Organization for Standardization
IoT	Internet of Things
JICA	Japan International Cooperation Agency
JP	Jeepney
kg	Kilogram
km	Kilometer
LEV	Light electric vehicle
LGe	Liters of gasoline equivalent
LGU	Local Government Units
LPTRP	Local Public Transport Route Plan
LCT	Low Carbon Transport
E-Trike Project	Market Transformation through the Introduction of Energy Efficient Electric Vehicle
ME	Mechanical Engineer
MW	Megawatt
MWh	Megawatt hour
MC	Memorandum Circular
$MtCO_2$	Metric tons of carbon dioxide
MMDA	Metropolitan Manila Development Authority
MARR	Minimum acceptable rate of return
MEP	Minimum Energy Performance
MFN	Most favored nation
MSME	Micro, small and medium enterprises
NCR	National Capital Region
NFP	National Focal Person
NGO	National Government Office
NTP	National Transport Policy
NDC	Nationally Determined Contributions
NICER	Niche Centers in the Regions
NOx	Nitrogen oxides
OEM	Original equipment manufacturers
PM	Particulate matter
Php	Philippine Peso
PDP	Philippine Development Plan

PEP	Philippine Energy Plan
PNS	Philippine National Standard
PSA	Philippine Statistics Authority
PHEV	Plug-in hybrid electric vehicle
PMO	Project Management Office
PUJ	Public utility jeepney
PUV	Public utility vehicle
PUVMP	Public Utility Vehicle Modernization Program
RBE	Registered Business Enterprises
RE	Renewable energy
RA	Republic Act
R&D	Research and Development
SCIT	Special Corporate Income Tax
SUV	Sports utility vehicle
SIPP	Strategic Investment Priorities Plan
TRAIN	Tax Reform for Acceleration and Inclusion
TESDA	Technical Education and Skills Development Authority
TVET	Technical Vocational Education and Training
TWG	Technical Working Group
TRCS	Training regulations and competency standards
TNVS	Transportation network vehicle service
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
UPS	United Parcel Service
UP	University of the Philippines
UV	Utility vehicle
VAT	Value-added tax

Foreword

The CREVI is essential tool for the Philippine government's high-level action plans in developing the EV industry. The CREVI outlines action plans for four components:

1. EV and EVCS,
2. Manufacturing,
3. Human Resource Development, and
4. Research and Development

The Roadmap provides specific targets and activities to ensure a sustainable and just transition to an electrified transport sector in the country. Moreover, the Roadmap recognizes the significant role of electrifying the transport sector in achieving the Nationally Determined Contributions and ensuring energy security in the country. Therefore, the government must utilize all available funding sources to promote the rollout of EVs and EVCS.

Overall, the CREVI presents an opportunity for the Philippines to establish a strong foothold in the EV industry, create new jobs, and enhance its position as a leader in sustainable transportation. By implementing the action plans outlined in the Roadmap, the country can accelerate its transition to a greener, more sustainable future.

I. Introduction

Mobility is a critical element of social and economic development. However, the current transportation model heavily relies on fossil fuel-based internal combustion engines (ICE), resulting in harmful emissions that negatively impact the environment and climate. In the Philippines, the transportation sector is the largest source of air pollution and energy-related greenhouse gas (GHG) emissions. In 2015, transport GHG emissions contributed to 34% of the total Philippine GHG emissions, with road transport accounting for 80% of those emissions.[1]

The DENR reports that 74% of air pollutants come from transport sources (e.g., cars, motorcycles, trucks, and buses). Transport sources account for 83.09% of NOx (0.40 Mt) and 37.73% of PM (0.29 Mt) of pollutants in Metro Manila.[2] The transport sector in the Philippines is energy-intensive and contributed about 35.6 metric tons of carbon dioxide equivalent ($MtCO_2e$) and 27.4 $MtCO_2e$ of emissions in 2019 and 2020, respectively.[3] Moreover, the price volatility of oil products and fears of fuel shortages, in addition to continued fuel dependence, pose a burden on our energy security, our economy, and the public.

To mitigate GHG emissions, transportation is a priority sector in the Philippines' NDC. Governments worldwide are shifting towards decarbonizing the transport sector in adherence to climate goals by adopting electric mobility or e-mobility. The Philippines has been pursuing this strategy for a long time, as seen in nationwide pilot activities, policies, and regulations that support the development of the EV industry. However, a roadmap is necessary to align multiple policy directions and programs, which is why the CREVI was established.

The EVIDA became law on April 15, 2022, as Republic Act 11697, which mandates the creation of CREVI. The roadmap focuses on the development of EV charging stations, manufacturing, research and development, and human resource development. It provides short-, medium-, and long-term targets to address the barriers to the EV industry and aims to address the fragmentation of public and private efforts by producing synergistic results from all activities to develop the EV industry.

With this, the transportation sector in the Philippines is a significant source of GHG emissions, air pollution, and energy dependence. However, with the establishment of CREVI, there is a roadmap that aligns with multiple policy directions and programs to address the challenges of the EV industry. This presents a significant opportunity for the Philippines to transition towards electric mobility and reduce its GHG emissions while improving air quality and energy security.

Furthermore, a more inclusive and sustainable adoption of EVs will require a robust local EV manufacturing industry which will make the availability of vehicles and parts more accessible to consumers.

[1] TRANSfer Philippines. (2015, September 14). *Philippines: Jeepney + NAMA* (Nationally Appropriate Mitigation Actions). http://www.transferproject.org/projects/transfer-partner-countries/philippines/

[2] Department of Environment and Natural Resources. (2018). *Emissions Inventory 2018*. https://air.emb.gov.ph/emission-inventory-2018/.

[3] DOE Key Energy Statistics 2020

II. Comprehensive Roadmap for Electric Vehicle Industry (CREVI) – Targets and Strategies

Vision and targets

After consultations, the following vision and goals for the EV industry are as follows:

2.1 Vision

To electrify a diverse range of vehicles and establish a domestic EV industry with strong export potential, with the aim of building a sustainable future, where new EVs and the required infrastructure are locally robust with reduced environmental impact.

2.2 Industry Goals

- Increase the utilization of EVs in the domestic market
- Deploy a sufficient number of EV charging points across the country between 2023 and 2040
- Position the Philippine EV industry to become a producer and exporter of EVs by 2040
- Promote sustainable economic growth and just e-mobility transition by protecting employment in the automotive industry and providing capacity-building activities and EV-specific transition programs
- Support research and development in battery research, and EVCS technology, and digitalization to spur technological innovations and strengthen the competitiveness of the local EV industry

COMPREHENSIVE ROADMAP FOR THE ELECTRIC VEHICLE INDUSTRY

C R E V I

Vision

To electrify a diverse range of vehicles and establish a domestic EV industry with strong export potential, with the aim of building a sustainable future, where new electric vehicles and the required infrastructure are locally robust with reduced environmental impact.

BUSINESS AS USUAL SCENARIO: TEN PERCENT (10%) EV FLEET SHARE BY 2040

ACTION PLAN

EV Demand Generation

	Demonstration and deployment of EVs
All Government agencies and corporate sector	Refleeting of vehicles for government and the private sector
All Government agencies and corporate sector	Monitoring of EV refleeting mandates
	Promote the use of EV and EVCS

Manufacturing Development

	Manufacturing of EVs, including 2-, 3-, and 4-wheelers, with focus of commercial vehicles
	Manufacturing of EV strategic parts and components such as automotive electronics, batteries, and charging stations

Research and Development

	Battery storage research and commercialization
	Battery manufacturing and utilization of indigenous minerals for alternative battery component production
	EV manufacturing including rail, air, sea transport vehicles

Human Resource Development

	Capacity Building for EV and EVCs manufacturing and maintenance
	Promote entrepreneurial models for the local businesses in the local EV supply chain
All Government agencies and offices	Capacity Building of the deployment of EVs and EVCs at the local level
	International Partnerships

Policy Development

	Standardization of EVCS and EV, and harmonization of charging protocol
	Standardization EVCS Installation/Construction
	Open and Public Data for EVCs and EV
	Implement Fiscal and Non-Fiscal Incentives
	Strengthening of Government Agencies Concerned
	Promote utilization of EVs in the locality and tourism sector
	Financing Support
	Waste Management, Recycling, and conversion of ICE vehicles
	Integrate EVCS with clean energy sources
	Electric Vehicle Incentive Strategy and Transport Policy harmonization

SHORT TERM (2023-2028)

EV and EVCS Targets

311,700 Electric Vehicles

7,400 EV Charging Stations

Cars:	81,500 HEV 13,600 PHEV 13,600 BEV
Tricycle:	37,500 BEV
Motorcycle:	164,900 BEV
Bus:	600 BEV

*cars includes sedan, SUVs, and UVs

MEDIUM TERM (2029-2034)

EV and EVCS Targets

580,500 Electric Vehicles

14,000 EV Charging Stations

Cars:	49,000 HEV 24,600 PHEV 123,000 BEV
Tricycle:	71,000 BEV
Motorcycle:	311,800 BEV
Bus:	1,200 BEV

*cars includes sedan, SUVs, and UVs

LONG TERM (2035-2040)

EV and EVCS Targets

850,100 Electric Vehicles

20,300 EV Charging Stations

Cars:	36,600 HEV 36,600 PHEV 219,400 BEV
Tricycle:	103,400 BEV
Motorcycle:	454,400 BEV
Bus:	1,800 BEV

*cars includes sedan, SUVs, and UVs

COMPREHENSIVE ROADMAP FOR THE ELECTRIC VEHICLE INDUSTRY

C R E V I

Vision

To electrify a diverse range of vehicles and establish a domestic EV industry with strong export potential, with the aim of building a sustainable future, where new electric vehicles and the required infrastructure are locally robust with reduced environmental impact.

CLEAN ENERGY SCENARIO: FIFTY PERCENT (50%) EV FLEET SHARE BY 2040

ACTION PLAN

EV Demand Generation

- Demonstration and deployment of EVs
- All Government agencies and corporate sector: Refleeting of vehicles for government and the private sector
- All Government agencies and corporate sector: Monitoring of EV refleeting mandates
- Promote the use of EV and EVCS

Manufacturing Development

- Manufacturing of EVs, including 2-, 3-, and 4-wheelers, with focus of commercial vehicles
- Manufacturing of EV strategic parts and components such as automotive electronics, batteries, and charging stations

Research and Development

- Battery storage research and commercialization
- Battery manufacturing and utilization of indigenous minerals for alternative battery component production
- EV manufacturing including rail, air, sea transport vehicles

Human Resource Development

- Capacity Building for EV and EVCs manufacturing and maintenance
- Promote entrepreneurial models for the local businesses in the local EV supply chain
- All Government agencies and offices: Capacity Building of the deployment of EVs and EVCs at the local level
- International Partnerships

Policy Development

- Standardization of EVCS and EV, and harmonization of charging protocol
- Standardization EVCS Installation/Construction
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- Strengthening of Government Agencies Concerned
- Promote utilization of EVs in the locality and tourism sector
- Financing Support
- Waste Management, Recycling, and conversion of ICE vehicles
- Integrate EVCS with clean energy sources
- Electric Vehicle Incentive Strategy and Transport Policy harmonization

SHORT TERM (2023-2028)

EV and EVCS Targets

2,454,200 Electric Vehicles

65,000 EV Charging Stations

Cars*:	415,000 HEV 69,000 PHEV 69,000 BEV
Tricycle:	419,000 BEV
Motorcycle:	1,480,000 BEV
Bus:	2,200 BEV

*cars includes sedan, SUVs, and UVs

MEDIUM TERM (2029-2034)

EV and EVCS Targets

1,851,500 Electric Vehicles

42,000 EV Charging Stations

Cars*:	234,000 HEV 80,000 PHEV 327,000 BEV
Tricycle:	262,000 BEV
Motorcycle:	947,000 BEV
Bus:	1,500 BEV

*cars includes sedan, SUVs, and UVs

LONG TERM (2035-2040)

EV and EVCS Targets

2,001,600 Electric Vehicles

40,000 EV Charging Stations

Cars*:	107,000 HEV 107,000 PHEV 641,000 BEV
Tricycle:	223,000 BEV
Motorcycle:	922,000 BEV
Bus:	1,600 BEV

*cars includes sedan, SUVs, and UVs

III. Electric Vehicle Industry Current Scenario

3.1 Global Trends and Scenario

Based on the 2022 Global EV Outlook by the IEA, global sales of EVs has been reported to have increased in 2021 despite the Covid-19 pandemic and supply chain challenges. The sales of BEVs and PHEVs nearly doubled year-on-year to 6.6 million. China and Europe accounted for more than 85% of global electric car sales in 2021, followed by the United States *(Figure 1)*. This is a positive sign for the EV industry, which is experiencing growth in demand.

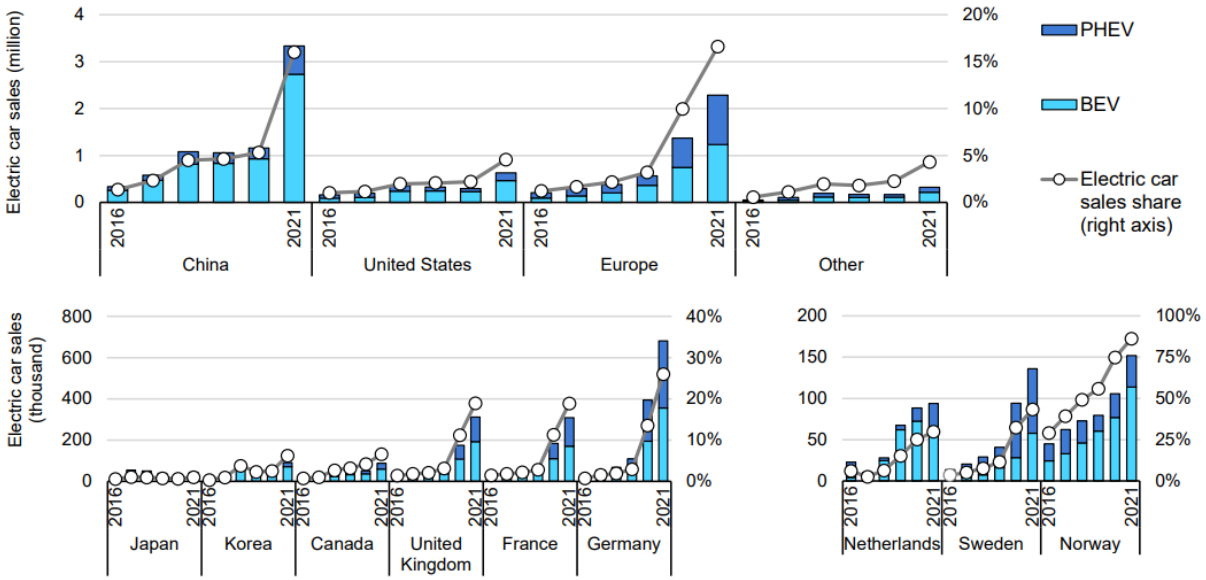


Figure 1. Electric Vehicle Sales in Countries with the World's Largest EV Market
Source: Global EV Outlook 2022

Moreover, the number of publicly accessible EV charging points worldwide approached 1.8 million, with China having the largest number of publicly available chargers, followed by Europe. The growth rate of publicly accessible chargers was lower in 2021 compared to the pre-pandemic roll-out rates, but public slow charger installations are still increasing. Consumers will expect more public charging infrastructure as the demand for EVs grows. *(Figure 2)*

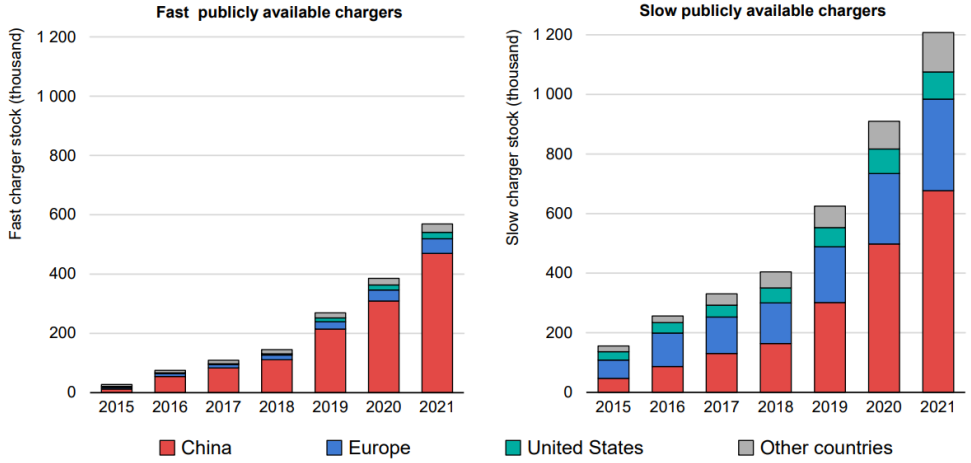


Figure 2. Available Fast and Slow Publicly Available Chargers in Countries with Major EV Markets
Source: Global EV Outlook 2022

For other EV markets, there was a significant growth in emerging markets in 2021, particularly in Asia, Eastern Europe, Central and West Asia, and Latin America and the Caribbean. The increase in sales was led by BEVs in Eastern Europe, Central and West Asia, while Latin America and the Caribbean had evenly split sales between PHEVs and BEVs. Further, the electric vehicle market in the ASEAN was valued at approximately $500 million in 2021 and is expected to reach $2.7 billion by 2027[4]. Despite this growth, the availability of EV models in emerging markets remains limited, with only less than 40 models available in emerging Asian markets. Addressing this issue could support further growth in the EV market, and the Philippines is well-placed to take advantage of this trend. With appropriate policies and initiatives, the country can become a significant player in the EV market and contribute to a more sustainable future.

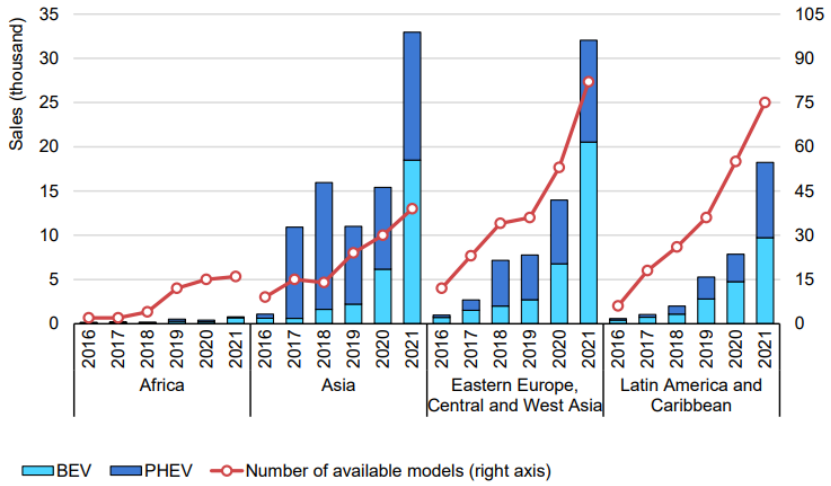


Figure 3. EV Sales in other Markets and EV Model Availability
Source: Global EV Outlook 2022

3.2 Local Trends and Scenario

3.2.1 Electric Vehicle Local Scenario

The available EVs in the country include motorcycle/TC, cars/sedan, and SUVs/UVs. In 2021, the DOTr-LTO recorded the number of registered EVs at only ≈9,000 units out of the nearly thirteen million (≈ 13,000,000) registered motor vehicles *(Table 1)*. There are eight (8) models of e-TC available in the local market wherein six (6) are locally made and two (2) are imported. About 15 electric cars/sedans/SUVs/UVs models are available comprising of seven (7) BEVs, eight (8) PHEVs and HEVs.

Table 1. Number of registered motor vehicles

Type of Motor Vehicle	*No. of ICEV registration*	*No. of EV registration*
Cars/sedan	1,221,074	7,503
SUV/UV	3,168,602	254
Motorcycles/TC	8,070,821	834
Bus	25,986	-
Trucks/trailers	536,000	2

Source: DOTr-LTO 2021 Motor Vehicle Registration

[4] https://seads.adb.org/solutions/asean-gears-shift-electric-vehicles

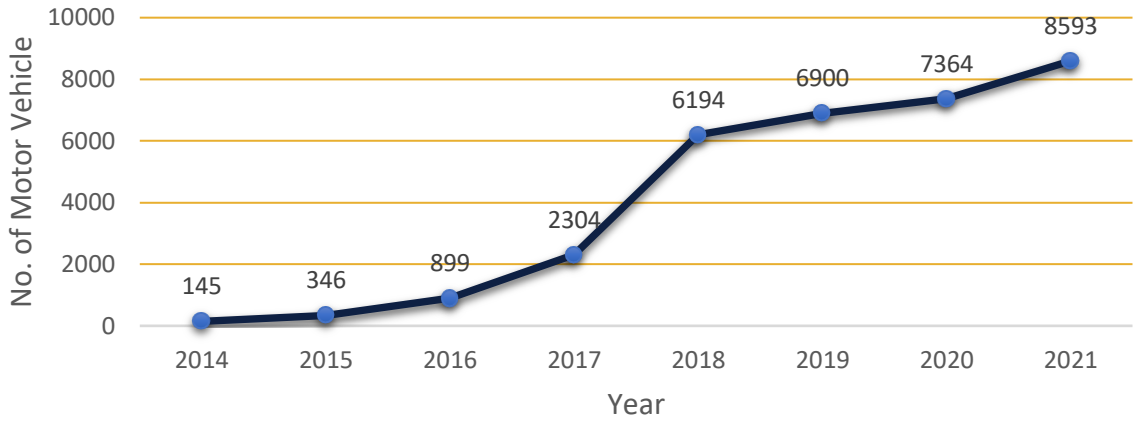


Figure 4. Cumulative Numbers of EV Registration from 2014-2022
Source: DOTr-LTO 2021 Motor Vehicle Registration

Nationwide, motorcycles remain to be the primary choice of vehicle across the region *(Figure* 5*)*. Motorcycle ownership is higher in non-urbanized areas compared to urbanized areas where four-wheeled vehicles cars/sedan and SUV/UVs take up a significant share.

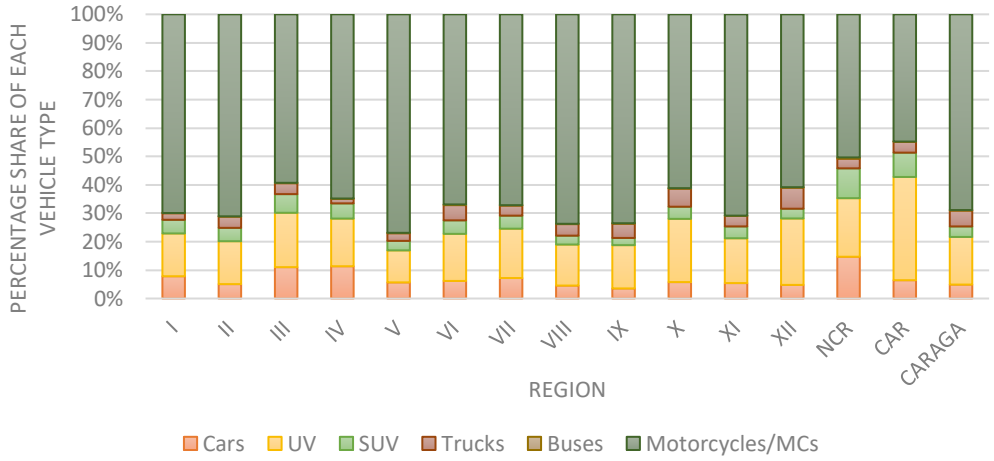


Figure 5. Vehicle Type Breakdown by Region, 2021
Source: DOTr-LTO 2021 Motor Vehicle Registration

The rise in EV registrations in 2019 was mainly due to the increase in local availability of electric cars/sedans and SUVs/UVs, while the dip in 2020 was attributed to the economic uncertainty during the pandemic. Most EV registrations before 2019 were traced to donated units from the international community, while the rise in SUV registrations in 2018 was mainly due to foreign government-donated PHEV SUVs to government agencies.

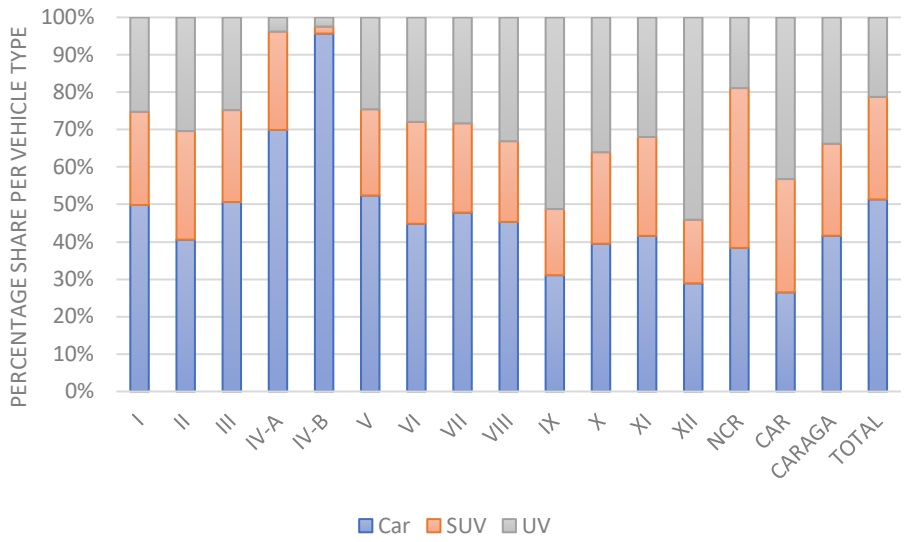


Figure 6. Breakdown of ratios between cars, SUVs, and UVs by region, 2021
Source: DOTr-LTO 2021 Motor Vehicle Registration

There are positive strides towards pushing for sustainability in the Philippine transport sector. The adoption of electric vehicles, particularly in public transport and logistics, is a significant step towards reducing greenhouse gas emissions and improving air quality. The adoption of e-UVs in 2019 was mainly attributed to the electric JP adoption under the PUVMP, while the rise in e-TC numbers in the country was mostly accounted for by the e-TC initiatives of LGUs. The government's initiatives to promote electric vehicles, such as the PUV modernization program and the DOE E-Trike Project, have been successful in increasing the number of electric jeepneys and tricycles on the road. The collaboration between LTFRB, Meralco, and city governments for the “eSakay” route and the trial of electric jeepneys in Iloilo City are also positive developments.[5,6]

It is particularly noteworthy that logistics companies, such as DHL Express Philippines and Mober, are refleeting for electric vehicles. DHL Express Philippines has expanded its fleet of EVs to promote green logistics and reduce its environmental impact. The company has added 13 e-UV and five (5) e-MC, which can travel up to 250 km and 140 km, respectively, when fully charged. These vehicles will be deployed in several cities, including Makati, Ortigas, and Manila, as well as Laguna and Clark, Pampanga. Moreover, Mober, Ikea's on-demand delivery partner in the Philippines, has introduced 10 electric vans and two electric trucks to its fleet to deliver Ikea purchases to customers' homes. This move towards sustainability sets an example for other local delivery services to follow.[7,8]

Additionally, the partnership between Globe's 917Ventures, Ayala Corporation, and Gogoro is another exciting development that aims to reduce fossil fuel usage in the transportation industry. The launch of a test fleet of Gogoro Smartscooters, smart batteries, and GoStations in Metro Manila in Q1 2023 is a step towards creating a sustainable business model for other Philippine cities. This aligns with the government's development agenda for digitalization and climate action, and Globe has also launched electric-powered shuttles for its employees to reduce greenhouse gas emissions.[9]

[5] https://www.pna.gov.ph/articles/1194035
[6] https://www.rappler.com/nation/221293-new-electric-jeepney-makati-mandaluyong/
[7] https://www.dhl.com/ph-en/home/press/press-archive/2022/dhl-express-introduces-electric-vehicles-for-sustainable-logistics.html
[8] https://www.topgear.com.ph/news/industry-news/ikea-mober-ev-a962-20230208
[9] https://www.bworldonline.com/velocity/2023/02/27/506820/ayala-group-brings-in-electric-smartscooters/

Finally, the surge in sales of electrified vehicles in 2022 is a positive trend. Sales performance of EVs were recorded at 3,091 units sold, in contrast to 843 units in 2021, 378 units in 2020, and 214 units in 2019. HEVs represented over 90% of total sales, and Toyota and Lexus were the dominant brands, selling 2,134 units last year. However, their market share decreased from 95% to 69% between 2021 and 2022. Toyota alone accounted for 59% of total sales, selling 1,829 units, largely driven by the success of the Corolla Cross hybrid model, which represented 62% of total Toyota sales. It is encouraging to note that other brands that made sales include Nissan, Mazda, Volvo, Mitsubishi, Jaguar, BMW, and Hyundai.[10]

3.2.2 Electric Vehicle Charging Station (EVCS) Local Scenario

The DOE has issued its EVCS Policy Guidelines (DC No. 2021-07-0023) which aims to promote the adoption of electric vehicles in the country by developing a robust charging infrastructure. Despite the availability of 338 EV charging stations across the country, only 32 have registered *(Figure 7)* with the DOE, comprising 258 AC chargers, 59 DC chargers, and 21 battery-swapping stations *(Figure 8)*.

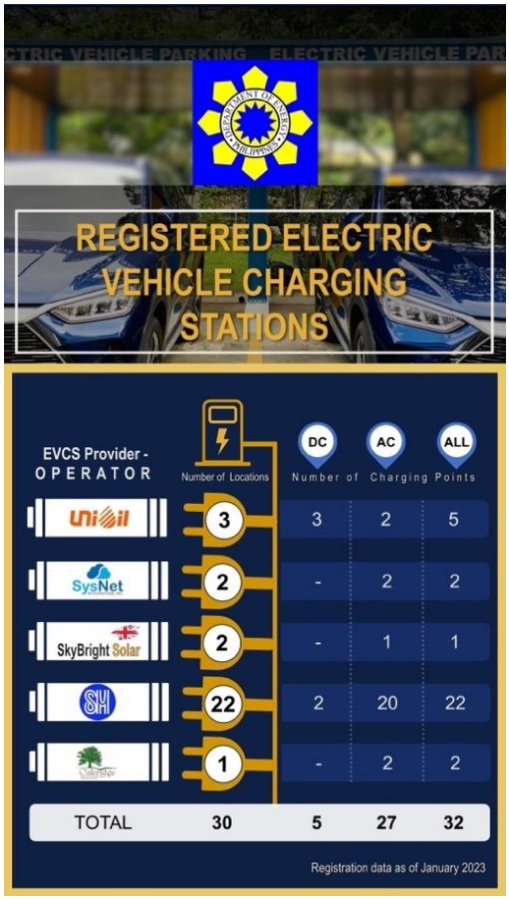
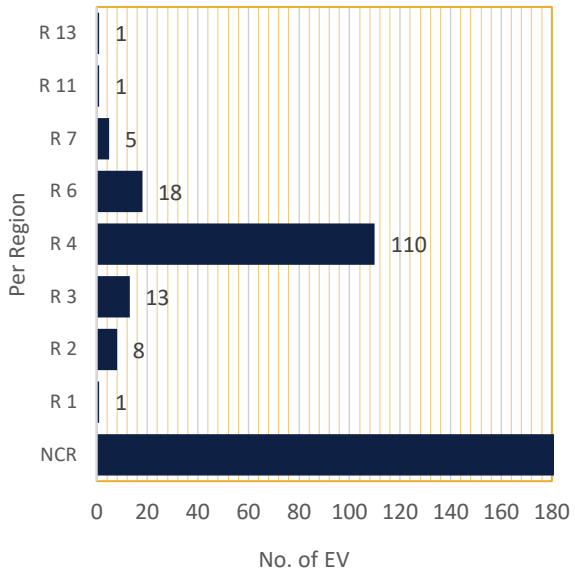


Figure 7. Registered EVCS under DC2021-07-0023

[10] https://malaya.com.ph/news_business/sales-of-evs-triple/



Region	AC chargers	DC chargers	Battery Swapping Stations	TOTAL
NCR	141	38	2	181
I	1	-	-	1
II	6	2	-	8
III	12	1	-	13
IV	92	17	1	110
VI	4	-	14	18
VII	1	1	3	5
XI	1	-	-	1
XIII	-	-	1	1
TOTAL	258	59	21	338

Figure 8. Number of EV Charging Station Nationwide as of February 2023

One notable partnership is between Pilipinas Shell Petroleum Corporation and SUN Mobility, which seeks to explore the feasibility of deploying SUN Mobility's advanced battery-swapping technology for two and three-wheel EVs in the Philippines. This initiative aligns with the Electric Vehicle Industry Roadmap for the Development of EVs in the Philippines (EVIDA), which aims to promote sustainable electric transportation in the country. The pilot program is set to launch in the first half of 2023. This will utilize SUN Mobility's Smart Batteries, Quick Interchange Stations, and Smart Network cloud-based Internet of Things (IoT) backend software. The initiative will allow two- and three-wheeled EVs to swap batteries in less than two minutes at selected Shell mobility stations. This innovative solution will not only provide an affordable and practical charging option but also enable longer driving ranges and zero-emission transportation. It is an exciting development that could accelerate the adoption of EVs in the Philippines.[11]

The implementation of more charging stations will be crucial to increase the convenience and accessibility of EVs, particularly in urban areas. The Philippines has a vast potential for electric vehicles due to the country's high reliance on fossil fuels, and increasing the adoption of EVs will reduce greenhouse gas emissions, improve air quality, and promote sustainable development.

3.2.3 Manufacturing Local Scenario

The strides in attracting investments from OEMs and Tier 1 automotive suppliers into the country create a strong potential in jumpstarting the development of EV industry. The country has a growing automotive industry, with 256 companies catering to the domestic and export markets, hence, these accumulated parts-making and assembly capabilities in ICEVs can be leveraged in the eV transition, not only for the common parts in ICEVs and EVs, but in new strategic areas such as automotive electronics, batteries, and charging stations.

With the increasing share of electrical and electronics components in the EV's value and volume, the country's export-oriented electronics industry and upstream mining resources (such as Nickel and

[11] https://mb.com.ph/2023/01/17/pilipinas-shell-sun-mobility-to-bring-advanced-battery-swapping-technology-for-electric-mobility-to-the-philippines/

Cobalt) can be tapped for the local development and manufacturing of EVs and their parts and components, that will serve not only the domestic market, but also the export market.

In terms of EVs, the Philippines has been producing and assembling electric tricycles for more than a decade. Currently, seven local companies are engaged in the production or CKD assembly of e-trikes. Furthermore, local manufacturing and assemble of 4-wheeled vehicles are centered on e-JP to cater to the domestic market. However, the untapped demand potential currently only warrants investments on-demand and fabrication-based manufacturing. With demand generation initiatives and targeted manufacturing incentives, through the Electric Vehicle Incentive Strategy (EVIS), the industry can transform into a more robust and globally competitive sector.

Table 2. Major Auto Parts Produced in the Philippines

Product	Firm	Quality Accreditation	Major Clients (Countries)
Chassis Systems			
Transmissions	Asian Transmission Corporation	ISO 14000	Mitsubishi (Japan, Thailand, Philippines, Indonesia), Isuzu, Nissan
	Honda Parts Manufacturing	ISO 9000	Honda (Japan, Indonesia, India, Thailand, UK, USA, Pakistan)
	Toyota Auto Parts	ISO 14000	Toyota (Thailand, India, Indonesia, South Africa, Philippines, Argentina)
	Isuzu Auto Parts	ISO 9001	Isuzu (Thailand)
Radiators, stamped parts	Roberts Automotive & Industrial Parts Manufacturing.	ISO 9002	Mitsubishi, Honda, Hino, Columbian, Universal Motors
Body System			
Chassis	KPC	Unavailable	Mitsubishi (Philippines, Brazil, Iran), Toyota, Isuzu (Philippines, Vietnam), Nissan, Suzuki Motorcycles, Kawasaki, Suzuki Motors Pakistan, Vietnam Motors
Electronics/Electrical Systems			
Wire Harnesses	Yazaki- Torres Manufacturing	QS 9000, ISO 14001, ISO 9001, Ford Q1	Ford, Jaguar, Toyota, Mitsubishi, Mazda, Honda, Isuzu, Nissan, Universal Motors Corp.
	International Wiring Systems Corp. (Phils)	ISO 9002, QS 9000, ISO 14000	Sumitomo Wiring Systems (Japan, USA, Australia)
	Pilipinas Kyohritsu	ISO 9002, QS 9000	Nissan Motor (Japan, Philippines), Nissan Diesel, Universal Motors Corp.
Electronic Components	Continental Temic	ISO/ TS16949, ISO 14001, ISO 17025, ISO 50001	Tier I suppliers in North America (44%), Europe (37%), Asia (19%).

Source: Department of Trade and Industry (DTI)

In addition to this, Chinese company Jiangsu Fengchuen New Energy Power Technology Co. Ltd has submitted a formal proposal to the Bacolod City government to establish an EV manufacturing plant, with a proposed investment of $200 million. The company plans to introduce test units in the city's public transportation system, with the proposed vehicle designed to resemble the iconic "Sarao" JP to preserve the cultural identity of Filipino public transport. [12][13]

[12] https://www.autoindustriya.com/auto-industry-news/mitsubishi-to-build-minicab-miev-in-asean-will-ph-get-it.html

[13] https://www.pna.gov.ph/articles/1195658

Meanwhile, Wyntron Inc., an electronics manufacturer, has received a $20 million loan from the ADB to expand its production of EV charging equipment in Cavite, Philippines. The loan will be used to purchase and refurbish production facilities and machinery to increase production capacity for residential and commercial EVCS. The EVCS will be able to provide overnight or four-to-six-hour fast charging and will have bi-directional functionalities to allow a charged car battery to power the home grid through the charger. The loan will help generate export revenue and provide employment opportunities and training for local skilled workers, engineers, and graduates. A gender action plan will also be developed to enhance women's participation in management training, career development programs, paid internships, and training on anti-sexual harassment and gender equality programs.[14]

With these developments, there are exciting opportunities for the Philippines to expand its local EV manufacturing and assembly capabilities, which will create jobs, generate export revenue, and contribute to the country's transition to sustainable and clean transportation.

3.2.4 Battery Supply Chain Local Scenario

The battery manufacturing industry in the Philippines is currently limited to the production of lead-acid batteries and battery pack assembly of lithium-ion-based batteries, as shown in Table 3. The majority of lead-acid batteries are produced by Philippines Batteries, Inc. under the Motolite brand. However, advanced battery pack assembly is mainly limited to smaller items used in consumer electronics and remote power applications.

Table 3. Battery Companies in the Philippines

Company name	Product/Services	End-application Industry	Plant Location
Go Green Power Technology Solutions	Manufacturer of lithium battery packs	Electric Vehicles	Sucat, Parañaque City, Metro Manila
AcBel Polytech Philippines, Inc.	Manufacturer of lithium-ion battery packs	Consumer Electronics	Laguna
Philippine Batteries, Inc.	Manufacturer of lead-acid batteries	Automotive, Power Industry	Bulacan
Hitachi Chemical Energy Technology Co. Ltd.	Manufacturer of valve regulated lead-acid (VRLA) batteries for export	Marine, Telecommunications, Power, Information Technology (IT), Cargo movement	Cavite Economic Zone
Imarflex Battery Manufacturing Corporation	Manufacturer of lead-acid batteries	Automotive	Pasig City
Lead Core Technology System, Inc.	Assembler and distributor of customized battery packs, utilizing VRLA, vented type lead acid (VTLA), nickel-cadmium, and lithium-ion batteries	Marine, Telecommunications, Power, IT, Cargo movement	Valenzuela City Quezon City Subic Pampanga

[14] https://www.philstar.com/business/2023/02/23/2246872/e-vehicle-charger-maker-gets-20-million-adb-loan-expansion

People's International Enterprises	Assembler and distributor of off-the-shelf and customized battery packs, utilizing VRLA, VTLA, nickel-cadmium, and lithium-ion batteries	Marine, Telecommunications, Power, IT, Cargo movement	Valenzuela City
Standard Manufacturing Company, Inc.	Manufacturer of lead-acid batteries	Automotive	Valenzuela City

Source: Philippine EV Policy Analysis Report, 2019

The production of batteries, particularly for lithium batteries, requires nonferrous metals and minerals such as lithium, cobalt, nickel, manganese, graphite, copper, and aluminum, some of which can be found in the Philippines. The country is a significant producer of various minerals, including gold, silver, copper concentrate, and specifically nickel and cobalt, which are key minerals in the production of lithium-ion batteries.

For instance, in 2021, the Philippines produced 25,332 kilograms of gold and 30,856 kilograms of silver. Copper concentrate production reached 214,684 dry metric tons. The copper content of concentrate amounted to 51,586 metric tons. The country is also a major producer of mixed nickel-cobalt sulfide and mixed nickel-cobalt sulfide metal, producing 75,400 metric tons and 43,493 metric tons, respectively, in 2021. The Philippines also produced 16,008 dry kilograms of scandium oxalate, a rare earth mineral, in the same year. Other minerals produced in the country include nickel direct shipping ore and chromite, with nickel content of ore reaching 386,359 dry metric tons and chromite production reaching 30,721 metric tons. Iron ore production amounted to 77,536 metric tons in 2021, providing employment to 183,852 people in mining and quarrying[15].

In addition, in 2021, the value of mineral production in the Philippines reached 180 billion pesos. Figure 9 shows the breakdown for the 2021 Annual Value of Production of the Philippine Metallic Mineral.

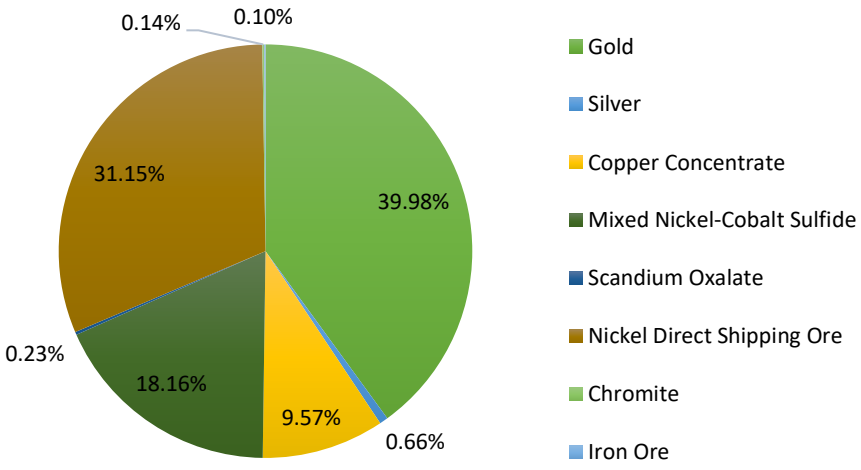


Figure 9. 2021 Annual Value of Production of the Philippine Metallic Minerals

[15] http://databaseportal.mgb.gov.ph/mgb-public/api/attachments/download?key=fy1oPnTkQ5mSs4Dhi8NhxPS5gsbjhDRfuEKu7gpkWQ6ThcpbWMrbsAJmT7paBajZ

Based on the data[16], Philippines has three percent (3%) global cobalt supply source share in 2019 *(Figure 10)*.

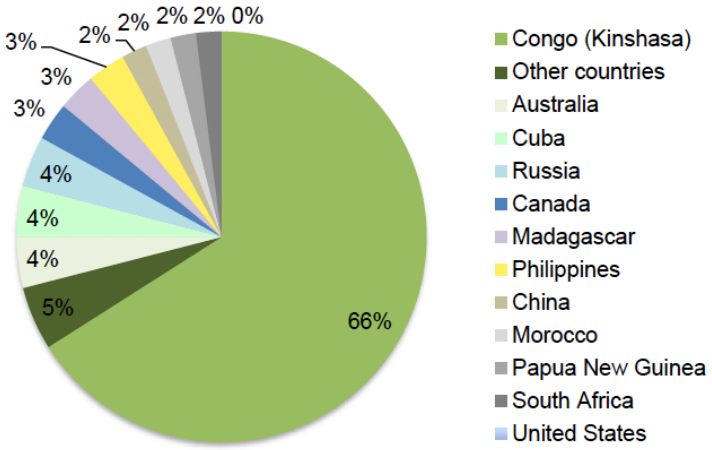


Figure 10. Country share of mined cobalt supply 2019
Source: Philippine Electric Vehicle Policy Analysis Report

It has been reported that the Philippines could leverage on its nickel reserves. The Philippines' local nickel reserves mostly come in laterite form, which is less preferred than the purer nickel sulfate form[17]. The following provinces have documented operating nickel mines:

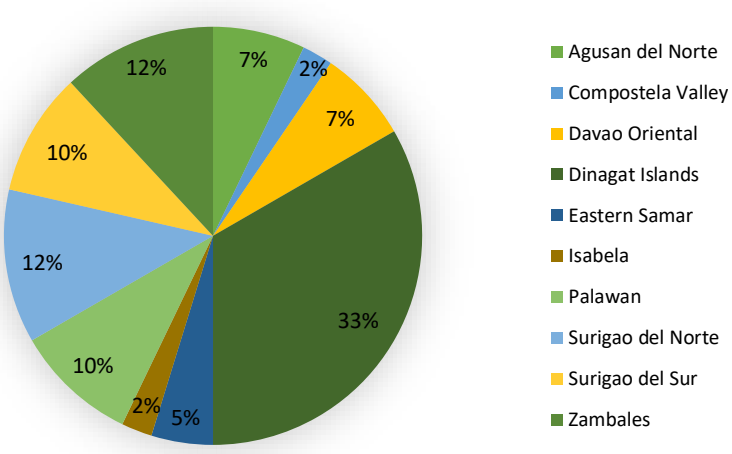


Figure 11. Percentage of Total Operating Nickel Mines by Province

However, nickel laterite ores require HPAL, an expensive and complicated process, to transform them into a usable form for battery production. While Sumitomo has shown interest in investing in a third HPAL plant in the country, its output is expected to be shipped to their Harima and Niihama Nickel refineries for further processing, as done in their existing plants[18].

The Philippines can encourage HPAL investments like its ASEAN neighbor, Indonesia, through limiting the export of unprocessed nickel ores and offering attractive manufacturing incentives. Moreover, battery cell manufacturing (lithium) facilities (BCM) would consume approximately 50-65 kWh (180-

[16] Philippine Electric vehicle Policy Analysis Report

[17] https://nickelinstitute.org/media/1190/thelifeofni.pdf

[18] HPAL Technology for Nickel Recovery | Sustainability | Sumitomo Metal Mining Co., Ltd. (smm.co.jp)

230 MJ) of electrical energy per kWh of battery capacity, without factoring in other aspects of the supply chain such as material extraction and processing[19]. To illustrate, a BCM with a 1 GWh annual battery capacity would require 50-65 GWh to produce enough batteries to power 10,000 four-wheeled EVs.[20]

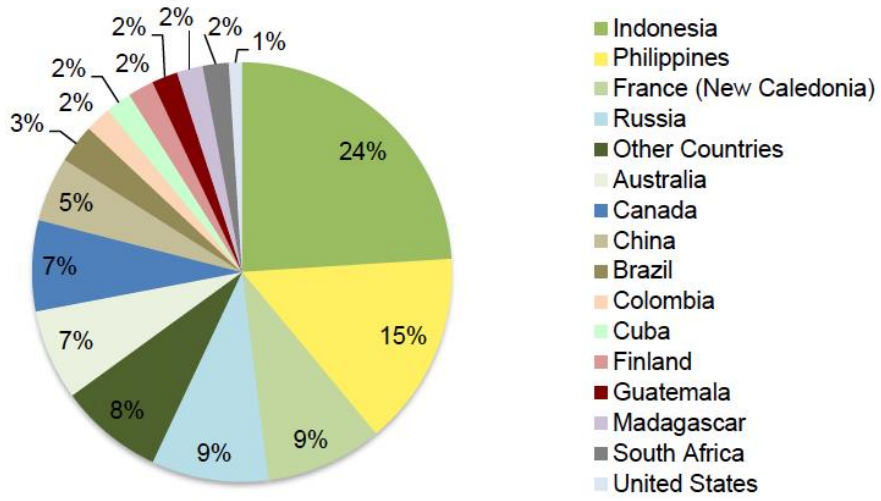


Figure 12. Country share of global nickel supply 2018
Source: Philippine Electric Vehicle Policy Analysis Report

Batteries account for about 40% of the production cost of EVs, making it crucial for the Philippines to be part of the battery supply chain, especially for locally produced models. The country will need to ensure sufficient energy resources to power HPAL plants or other mineral refinery plant to purify its nickel and other minerals reserves. The plants can contribute to production of power electronics components and assembly of lithium battery packs. This is while the country develops and implements a long-term program to become a main player in the production of newer generation chemistries such as solid-state batteries.

3.2.5 Human Resource Local Scenario

The EV industry requires a high level of technical competencies, including power electronics, control systems, electrical safety, battery technologies, and battery management systems. Fortunately, the skilled workforce in the Philippines can play a crucial role in the growth of the EV industry. According to the PSA, the country's employment rate in 2022 was estimated at 95.7%. This is higher than the 93.4% employment rate recorded in 2021. Further, the results of PSA's 2022 Labor Force Survey are detailed below.[21]

- Highest year-on-year increase in the number of employment in December 2022:
  a. Wholesale and retail trade, repair of motor vehicles and motorcycles (993,000);
  b. Other service activities (563,000);
  c. Administrative and support service activities (513,000);
  d. Accommodation and food service activities (470,000);
  e. Transportation and storage (275,000).

[19] https://iopscience.iop.org/article/10.1088/2515-7620/ab5e1e

[20] 1,000,000 MWh/ 100 kWh battery capacity = 10,000 vehicles

[21] https://psa.gov.ph/system/files/Press Release for Dec 2022 LFS.pdf

Table 4. Labor Force Percentage Rate, FY 2021

Philippines	Dec. 2021[f]	Jan. 2022[P]	Feb. 2022[P]	Mar. 2022[P]	Apr. 2022[P]	May 2022[P]	Jun. 2022[P]	Jul. 2022[P]	Aug. 2022[P]	Sept. 2022[P]	Oct. 2022[P]	Nov. 2022[P]	Dec. 2022[P]
Labor Force Participation Rate (%)	65.1	60.5	63.8	65.4	63.4	64.0	64.8	65.2	66.1	65.2	64.2	67.5	66.4
Employment Rate (%)	93.4	93.6	93.6	94.2	94.3	94.0	94.0	94.8	94.7	95.0	95.5	95.8	95.7
Underemployment Rate (%)	14.7	14.9	14.0	15.8	14.0	14.5	12.6	13.8	14.7	15.4	14.2	14.4	12.6
Unemployment Rate (%)	6.6	6.4	6.4	5.8	5.7	6.0	6.0	5.2	5.3	5.0	4.5	4.2	4.3

Notes:
[f] Estimates are final
[P] Estimates are preliminary and may change
Source: Philippine Statistics Authority, Labor Force Survey

Moreover, based on the Philippine EV Policy Analysis Report, various trainings and educational programs *(Table 5)* are needed to address skill requirements in the adoption of EVs[22].

Table 5. EV Industry Skill Requirements

Occupation	Description	Recommendations
EV Design and Development		**Possible Base Program**
EV Mechanical Design Engineer	Design, development and testing of EV mechanical systems	ME, with appropriate experience in vehicle design. Specialist programmes are needed as the occupation requires advanced mechanical simulation design skills, specializing on vehicle design, which is not adequately covered in current ME programmes.
EV Electrical Design Engineer	Design, development and testing of EV electrical systems	EE/ECE, with appropriate experience on EV electrical system design. Requiring a professional EE license.
Autotronics Software Programmers	Development, programming and testing of EV software systems	Computer Scientist or Computer Engineer with appropriate experience
EV Industrial Designer	Aesthetic design of EVs, taking into account technical system requirements	Industrial Design graduates
Battery Module Electrical Design Engineer	Design, development and testing of the electrical system of EV Battery modules based on a set of technical and economic specifications and constraints	EE/ECE, with appropriate experience. Requiring a professional EE license is recommended considering the power ratings involved. Training programmes must be considered since the occupation requires advanced design skills and battery safety knowledge, which are not adequately covered in current EE / ECE courses

[22] Philippine Electric Vehicle Policy Analysis Report, 2019

Occupation	Description	Recommendations
Battery Mechanical and Thermal Design Engineer	Design, development and testing of thermal, dynamic impact and elemental protection system of EV battery modules based on a set of technical and economic specifications and constraints	ME, with appropriate experience. Training programmes must be considered since the occupation requires advanced thermal and mechanical simulation and design skills and battery safety expertise, which are not adequately covered in current ME courses
Parts and Vehicle Manufacturing		**Possible Base Program**
EV Electrical Assembly Personnel	Preparation of wire harnesses and assembly of EV electrical systems	Automotive Electrical Assembly Specialist II, with additional specialist training on battery and EV safety. Currently, only two institutions offer the needed training, which needs to be addressed
EV Mechanical Assembly Personnel	Assembly of EV mechanical systems	Automotive Mechanical Assembly II, with additional specialist training on battery and EV safety. Currently, no institution offers programmes on Automotive Mechanical Assembly
EV Test Technician	Quality control testing of EV electrical and mechanical systems	Currently, no base programme is available. Preparation of an appropriate TESDA training regulation is recommended.
Vehicle Operations, Maintenance and Repair		**Possible Base Program**
EV Fleet Manager	Supervision of EV dispatching and scheduling, maintenance, financials, charging service / battery swapping, personnel management, and terminal management	No programme is currently available. Preparation of a training programme covering safety concepts and practices is recommended.
EV Electrical Service Technician	Maintenance and repair of EV electrical systems	Automotive Servicing II
EV Mechanical Service Technician	Maintenance and repair of EV mechanical systems	Automotive Servicing I, with additional focus on EV safety
EV Driver	Operation of e-trikes, e-jeeps, and e-buses	No programme is currently available. However, the TESDA driver certification training could be expanded to include topics on EV maintenance and EV safety and emergency response

Occupation	Description	Recommendations
Charging System Assembly and Installation		**Possible Base Program**
EVSE Electrical Supply System Designer	Design of appropriate power supply systems for EVSEs.	EE
EVSE Installation Technician	Installation of power supply systems and EVSE equipment, as per technical design	Electrical Installation and Maintenance II, with additional specialist knowledge on solar power installation
Charging System Operation		**Possible Base Program**
Charging Facility Manager / Safety Officer	Over-all supervision and safety of charging facilities and operation	Preferably a technical specialist with appropriate training on EVSE station and safety
Charging Service Personnel	EVSE safe operation	Currently, no training programme is available, which would need to be developed
Technical Support Associate *(for self-service charging)*	Orientation support for EV owners and/or drivers on EVSE use	
EVSE Repair and Maintenance	EVSE maintenance and repair, including troubleshooting of power line, as needed	Electrical Installation and Maintenance Specialist II, with specialist training on EVSE equipment
Sales and Marketing		**Possible Base Program**
EV Sales Representatives	Presentation, discussion of vehicle technical features, operation, and economics to prospective clients	Sales personnel, with orientation focused on EVs
EV Test Drive Support Staff	Test-drive support, including on-board testing, for clients	Must be a certified EV Driver
EV Customer Service Manager	Planning, direction, and coordination of after-sales requirements and activities, particularly on maintenance, with EV owners.	Current customer service managers may be tapped though orientation on the product and maintenance and repair processes involved would need to be conducted
Regulations		**Possible Base Program**
Vehicle Type Approval Assessors	Evaluation of EV models based on standard requirements	Engineering degree, with specialist training on EV standards and test procedures
EV Standards Test Technicians	Implementation of testing processes, as defined by the EV vehicle standards	Currently, no training programme is available, which would need to be developed
MVIS EV Testing Specialist	Implementation of testing processes as defined in the MVIS	
EV Environmental Officer (Battery Recycling)	Compliance monitoring on the safety and environmental requirements of EV battery and component storage and disposal	Currently, no training programme is available. Development of a specialist training on battery and EV parts disposal must be developed

Occupation	Description	Recommendations
Emergency Response and Recovery		**Possible Base Program**
Rescue service personnel	Rescue and recovery of people in accidents and disasters	Upgrading and certification of concerned personnel
Medical emergency service personnel	Provision of immediate medical services on people involved in accidents and disasters	Upgrading and certification of concerned personnel
Vehicle Recovery and Handling personnel	Recovery of vehicles involved in accidents and disasters	Upgrading and certification of concerned personnel
Fire fighting personnel	Fire control and management	Upgrading and certification of concerned personnel

Source: Philippine EV Policy Analysis Report, 2019

In reference to Table 5, the TESDA has developed ten (10) training regulations out of the twenty-six (26) EV industry skills requirements, with recorded accomplishments in developing the EV industry skill requirements. Also, in 2021, as recorded by TESDA, the following tables *(Table 6, Table 7)* show the accomplishments in developing the human resource skill sets for the automotive and land transportation sector:

Table 6. TESDA's Number of Enrollment, Graduates, Assessed and Certified related Automotive and Land Transportation, FY 2021

Region	Enrolled	Graduates	Assessed	Certified
I	8,769	7,780	5,537	4,956
II	6,792	5,751	4,804	4,719
III	6,166	5,625	6,336	5,612
IV-A	8,032	5,004	5,227	5,003
IV-B	10,775	9,602	4,945	4,824
V	7,081	6,937	4,289	3,457
VI	4,355	4,193	4,430	3,986
VII	5,677	5,407	5,391	5,355
VIII	3,337	4,278	5,428	5,341
IX	5,049	4,541	4,997	4,419
X	7,389	6,985	6,029	5,615
XI	6,232	5,654	4,725	4,415
XII	5,423	5,519	6,766	5,983
ARMM	2,190	2,091	1,686	1,652
CAR	5,719	5,755	3,394	3,210
CARAGA	7,507	6,653	2,523	2,029
NCR	3,976	3,148	3,201	3,091
Portfolio	-	-	561	552
RLA	-	-	10	10
Total	**104,469**	**94,923**	**80,279**	**74,229**

Assessors	1,276
NTTC Holder	3,196
Assessment Center	653
TVET Provider	172
Registered Program	197

Source: TESDA, 2021 TVET Statistics Annual Report, 2021

Table 7. Number of Assessment Centers, NTTC Holders and Assessors related to EV Industry Skill Requirements, FY 2021

Training Regulation	Assessment Centers	NTTC Holders	Competency Assessors
Automotive Electrical Assembly NC II	1	3	4
Automotive Servicing NC I	88	-	146
Automotive Servicing NC II	85	695	165
Electrical Installation and Maintenance NC II	212	1,490	597
PV Systems Installation NC II	39	192	53
Customer Services NC II	7	80	23
Emergency Medical Services NC II	10	79	25

Source: TESDA, 2021 TVET Statistics Annual Report, 2021

To further support the existing TESDA TRCs related to EVs, the DOE has developed a TESDA-aligned EV technician course module. This contains TRCS for EV and HEV servicing which is already posted on the TESDA website.

The EV technician course module includes the following *(Table 8)* competencies for a person to achieve and perform periodic maintenance (e.g., troubleshooting, repair, maintenance, etc.) of EV components in accordance with the manufacturers specifications including 2-, 3- and 4-wheeled EVs.[23]

Table 8. EV Technician course module

Competencies	Description
Validate EV specification	Technical skills development to check body type of the vehicle, check vehicle electric motor type, and check and validation of vehicle specification.
Move and position EV	Technical skills development to safely move and position the vehicle including systematic and efficient control of all vehicle functions.
Utilize automotive tools	Selecting and using automotive power tools, hand tools and tool-keeping.
Perform mensuration and calculation	Use of automotive measuring tools.
Utilize workshop facilities and equipment	Inspecting and cleaning of work area including tools, equipment and facilities. Storage of equipment, including operating of basic workshop equipment.
Prepare servicing parts and consumables	Prepare parts and consumables for gasoline and diesel engines in conducting preventive maintenance.
Prepare vehicle for servicing and releasing	Identifying and preparing the vehicles for servicing and releasing.

Core Competencies	Description
Repair electric motors and controls	Inspection, troubleshooting, repair and testing of EV motor parts and controllers. It also includes road test and commissioning of EV after the repair and completion of work process.

[23] Technical Education and Skills Development Authority (TESDA), "Competency Standards: Pure Battery Propelled Electric Vehicle Servicing Level II"

Replace battery	Inspect and test EV battery. It also includes testing and reading battery performance, capacity to charge, and tracing and replacement of damage module.
Perform periodic maintenance	Inspect and conduct periodic maintenance of an EV.

In addition, the DOE, in collaboration with the BFP, has developed an emergency response protocol. The protocol provides basic and advanced knowledge and skills in firefighting techniques involving PUVs, including EV to ensure the safety of the public in the use of EVs. However, there is still a shortage of human resources with EV technical competencies to meet the desirable EV demand, which is crucial to improving EV market awareness.

To increase the adoption of EVs and generate job opportunities, several private and public sector initiatives have been launched. PHLPost deployed their "Green Delivery" electric bicycles to deliver goods in Pasig City during the Enhanced Community Quarantine in 2020, in partnership with UNEP, Pasig Transport, the Pasig Government, and Chinese Manufacturer Tailing EVs Co. Ltd. (TAIL G).[24]

On the other hand, other vehicle industry stakeholders also started their engagement in the EV industry. To name a few, Mitsubishi Motors has been conducting technical service training for after-sales and seminars on handling, operating, and treating EVs safely. Ford has also conducted EV emergency response safety training specifically in preparation for emergency responses for EVs. This will also serve as an emergency response guide for customer reference. The local government of Malay is focusing on strengthening the e-TC program for the Boracay Island, which covers capacitating e-TC operators, drivers, and suppliers who were affected by the pandemic. The LGU of Malay is also working on improving its the boundary payments system, battery leasing services, financing scheme, and charging of batteries by e-TC suppliers.[25] Furthermore, Le'Guider International Electronic Assembly also provides conversion of vehicle to EV that provides other options for vehicles that will be displaced by vehicles and eliminate pollution generated by ICEV.

Moreover, the initiative of local governments, such as Malay, in focusing on the e-TC program for Boracay Island is an excellent example of how community development and EV deployment can work hand in hand. Projects like the Renergy Project, which involves the operation of an electric tricycle charging station that converts waste cooking oil into fuel, highlight the potential for sustainable and innovative solutions in the country.[26]

The government and industry stakeholders have recognized the need for training and educational programs to address the skill requirements in the adoption of EVs, and efforts are ongoing to strengthen the e-TC program and develop emergency response protocols. With continued support and collaboration, the Philippines can further advance its EV industry with the support of the government and private sector initiatives, to harness the benefits of the transition to electric vehicles.

[24] https://www.manilatimes.net/2020/04/06/public-square/phlpost-deploys-green-delivery-electric-vehicles-for-relief-operations-in-pasig-city/710229

[25] https://www.panaynews.net/boracay-e-trike-program-up-for-improvement-amid-complaints/

[26] https://business.inquirer.net/376392/boracay-e-trikes-to-get-fuel-from-waste-cooking-oil

3.2.6 Research and Development Local Scenario

The Philippines is making significant progress in the area of e-mobility innovation, thanks to the efforts of various research organizations. This includes the E-Mobility R&D Group at UP-Diliman Electrical and Electronics Engineering Institute and Cagayan State University, and funding from government bodies such as the Department of Science and Technology (DOST). These projects cover a range of areas, from the development of EV chargers and electric motors to the use of local resources in the creation of next-generation batteries.

Research programs such as the NICER for R&D Program of the DOST have contributed to long-term development in e-mobility innovation in the country. The E-Mobility R&D Group UP-Diliman Electrical and Electronics Engineering Institute heads several projects including e-vehicle development in collaboration with the Cagayan State University. Under this, a design for a solar EV charging station network has been adopted as part of the EV infrastructure of the Quezon City Government starting in December 2021. The technology developed for a new design of EV charger has been implemented as the product of CHRG EV Technologies, Inc. (funded by DOST PCIEERD), CharM charger. It is developed for use by e-TCs and EVs with support for IC cards and NFC payment methods (in this case, NFC stands for "near field card"). UP-Diliman Electrical and Electronics Engineering Institute also conducts research on electric motors, such as designs using the switched reluctance motor which can result in improved models of EVs being constructed in the future.

The DOE and DOST have also spearheaded and considered the development of EV in the marine vessel in partnership with the academe. These projects aim to provide alternative mode of transportation using electric drive system and a more sustainable ferry system. On the other hand, several research have already been conducted by DOST through the utilization of Philippines' ores, minerals and resources in the development of next-generation batteries.

Table 9 presents the previous and ongoing e-mobility projects in the country. Last September 2021 during the 9th EV Summit, Clean Air Asia and EVAP gathered all organizations with ongoing e-mobility projects in the country to a roundtable discussion about the update and ongoing projects. The session aimed at mapping the areas where projects overlap and differ in the scope for each intervention (i.e., policy development, pilot, capacity building). With this, opportunities were identified to address gaps and find potential synergies with projects of similar scope and type of intervention. Below is the outcome of the mapping summary based on the presentations of the project representatives.

Table 9. E-mobility research and development initiatives in the Philippines

Agency and E-mobility project name, Year	**Areas of intervention**	**Description**
DOST, UP, TIP *Advanced Cathode Materials based on Earth-Abundant Elements (Ni, Fe) for High Energy Density Next Generation Batteries and Pb-acid batteries life span improvement*	• Policy and program development • Pilot program • Capacity development and communication	The project will develop advanced high iron or nickel content cathodes for next-generation batteries (Li-ion, Na-ion, Mg-ion, multi-ion) to improve the performance and reduce the cost of future batteries. The project will cover four specific following objectives: material databases will be screened for existing compounds with properties that may be useful for battery applications; novel materials based on the screened materials will be synthesized and characterized; a cell using the synthesized material will be fabricated; and the performance of this cell will be optimized. For Ni-Fe and cobalt batteries, the project will identify potential improvement to reduce electrodes oxidation and eventually increase its lifespan.

Agency and E-mobility project name, Year	Areas of intervention	Description
thru embedded ultrasonics. (2021-2024)		Lastly, the lead-acid (Pb-acid) batteries lifespan improvement will be assessed using embedded ultrasonics. With this proposal, the Philippines can contribute in providing sustainable energy access by incorporating its resources in the development of next-generation batteries.
DOTR, UNDP *The Promotion of Low Carbon Urban Transport Systems in the Philippines (LCT) Project* (2019 – 2023)	• Policy and program development • Pilot program • Capacity development and communication	The DOTr and the UNDP, supported by the GEF are implementing the LCT Project. The scope entails policy research on private sector participation and investment in low carbon transport systems in the country. This project also has components with the key national agencies such the DOE, DTI, DOST, and TESDA. The LCT will be piloted in cities of Baguio, Santa Rosa, Pasig, and Iloilo at the LGU level.
DOE, DOST, Mapua University *Safe, Efficient, and Sustainable Solar-Assisted Plug-In Electric Boat (Sessy E-Boat)* (2021-on-going)	• Policy and program development • Pilot program • Capacity development and communication	The scope of the project is focused on the determination of strategies on the implementation of solar-assisted plug-in electric powered boats. The design and implementation of the power and control system for efficient and sustainable electric boats will be the primary scope of the project. This study will involve the prototyping of two (2) units of electric motor boats with solar panels. One (1) of the electric boats will use lead acid batteries while the other one (1) will use lithium-ion batteries, both with roofing mounted with solar panels. Moreover, this project will use the locally developed automatic identification system or AIS as safety feature and shall explore the development of controllers for autonomous electric boats.
DOST, UP *Prototype e-Boat for Inland Waterways to Address Urban Congestion* (2021-on-going)	• Policy and program development • Pilot program • Capacity development and communication	The project proposed to design, develop and pilot a sustainable ferry system in Pasig river. The system will be composed of an electrically-propelled ferry boat and charging infrastructure. The design of the boat, size of the components, and place of charging infrastructure, will be based on a techno-economic study comparing potential sustainable system configuration applicable to the Pasig river ferry system. A pilot system will be demonstrated with its performance compared to the current system in terms of economics, fuel efficiency, and environmental effect.
DOE, Worldbank *E-mobility Development Consulting* (2022)	• Policy and program development • Pilot program • Capacity development and communication	The DOE and World Bank provided a technical assistance project on the development of comprehensive EV road mapping for public transportation. This includes the development of policies, guidelines and standards for EVs, and conducting knowledge exchange workshops with experts and the DOE staff.

Agency and E-mobility project name, Year	Areas of intervention	Description
DOST, Cagayan State University *Viability Study of Conversion of Conventional Tricycle to E-Trike* (2022)	• Policy and program development • Capacity development and communication	For this study, the tricycle models available in the region are the target units to be converted to e-Trike. There are two (2) prevalent models in the region, and they are locally known as: "sidecar" and "center car". Lithium-ion battery will be used and a BMS will also be incorporated to protect the battery and prolong its service life.
DOE, DOST, UP *Optimal Placement of Electric Vehicle Charging Stations in a Local Public* (2021)	• Policy and program development • Pilot program • Capacity development and communication	The project envisions that the existing e-trikes from DOE can be used to cater as transport service by assigning pick-up points and drop off points.
DOST, EVAP *Development of a 23-seater electric jeepney* (2020)	• Capacity development and communication • Pilot Program	The scope of the project is to support the government's PUV Modernization Program to upgrade and modernize old, dilapidated jeepneys that are more than 15-year old. The development of the electric jeepney conforms to the DTI-BPS's PNS PUV body dimensions.
DOST, UP *AdVICE: Ad-hoc Vehicle Infrastructure Cooperative Environment* (2018)	• Policy and program development • Pilot program • Capacity development and communication	AdVICE is a TNVS system that consists of 1) a collection of ride-hailing algorithms 2) data harvesting of e-vehicles, and 3) ride-hailing application. AdVICE aims to make e-trikes more efficient for use as a transportation option in small communities.
DOST, UP *EmoCION: Electric Mobility and Charing Infrastructure Operating as a Network* (2020)	• Policy and program development • Pilot program • Capacity development and communication	A smart network of energy-aware EVs and EVCS will be developed under this initiative. There will be cooperation between EVs and infrastructure. The EV system operations such as scheduling of vehicles, route to take, charging designation, and charging time will all be coordinated under this system. A benefit of this initiative is the optimization of the overall energy demand of the EV system.
DOST, Cagayan State University	• Policy and program development	Saving the environment through minimal emission of engines is the focus of the study. The utilization and deployment of the e-Trike will create awareness and acceptability to

Agency and E-mobility project name, Year	Areas of intervention	Description
E-trike Deployment and Utilization Study (2018)	• Pilot program • Capacity development and communication	stakeholders in Tuguegarao City. Also, it provides information on the performance of the e-Trike in terms of mileage, and battery performance.
DOST, UP *Rapid Electric Vehicle Charging Station (CharM)* (2014)	• Pilot and program development	The project proposed a method to charge an e-tricycle to 80% capacity in no more than thirty (30) minutes, locally develop a fast EVSE and develop a user interface for a payment. CharM EV Fast Charging units are already being commercialized through the support of the DOST-PCIEERD Spin-Off Program.
Asian Development Bank (ADB), DOTr, Davao LGU *Davao Bus Project* (2021 – present)	• Policy and program development • Pilot program • Capacity development and communication	The ADB, DOTr and Davao City LGU have implemented the Davao Sustainable Urban Transport Project. This project details franchising plans and mechanisms to improve the integration of the public transport system, widen the coverage area, and deliver more transport services to passengers in Davao. In the High Priority Bus System components of the project, specifications for the use of electric buses were incorporated.[27]
SOLUTIONSplus consortium where Clean Air Asia and Pasig LGU are members SOLUTIONSplus: Urban Electric Mobility Initiative (UEMI)	• Pilot program • Capacity development and communication	The European Commission-funded SOLUTIONSplus project brings together highly committed cities, industry, research, implementing organizations and finance partners and establishes a global platform for shared, public and commercial e-mobility solutions to kick start the transition towards low-carbon urban mobility. The project supports the local EV start up industry, and explores integration of EU technologies and the relevant enabling ordinances and infrastructure decisions. Pasig City is a pilot site under this initiative.[28]
UNEP "Integrating Electric 2&3 Wheelers into Existing Urban Transport Modes in Developing and Transitional Countries" under the Global Electric Mobility Program	• Policy and program development • Pilot program • Capacity development and communication	The Philippines is also one of the focus countries of the UNEP for the initiative entitled, "Integrating Electric 2- and 3-Wheelers into Existing Urban Transport Modes in Developing and Transitional Countries,". This involves programs in six countries in Asian and African countries for the transition from internal combustion engines to electric and non-motorized two and three-wheelers. For the Philippines, the pilot city is Pasig City where the use of smaller modes of EVs are being explored for urban freight (e.g., mail and parcel delivery) in partnership with Philippine Postal Corporation and the local

[27] ADB. 2013. *Philippines: Davao Sustainable Urban Transport Project*. https://www.adb.org/projects/45296-003/main

[28] SOLUTIONSplus project page. Accessed January 10, 2022. http://www.solutionsplus.eu/partners.html.

Agency and E-mobility project name, Year	Areas of intervention	Description
(2017 to 2022)		government. The project is implemented by Clean Air Asia in the Philippines.[29]
Clean Air Asia, United Parcel Service (UPS) *CitySwitch to E-mobility in Pasig* (2021 to present)	• Policy and program development • Pilot program • Capacity development and communication	A partnership between Clean Air Asia and United Parcel Service (UPS) was established for the CitySwitch Program involving the Pasig City Government. This initiative aims to protect public health from the impacts of transport emissions by mainstreaming sustainable electric mobility solutions in the city's air quality management. The project aims to support Pasig City in the development of an e-mobility roadmap. In 2022, a pilot demonstration in Pasig was pursued as a follow-up to the e-mobility roadmap development.
United Nations Industry Development Organization (UNIDO) *Accelerating the adoption and scale-up of electric mobility for low-carbon city development in the Philippines* (2020-2025)	• Policy and program development • Pilot program • Capacity development and communication	Addressing the gaps in the charging infrastructure development, the project aims to deploy innovative charging infrastructure integrated with renewable energy. [30] The project also provides technical assistance and capacity development programs for the development of viable business models for electric 3-wheelers. The creation of an enabling policy environment for e-mobility industry development and partnerships for investment scale-up are also being pursued in this initiative.
DOE, ADB *E-trike Project* (2012 – 2019)	• Pilot program • Capacity development and communication	DOE, in partnership with the ADB and Clean Technology Fund (CTF), is implementing the Market Transformation through Introduction of Energy Efficient EVs Project or the E-Trike Project. It aims to reduce the sector's annual petroleum consumption by 2.8% (based on 20 million barrels annual consumption in 2010) and to avoid CO_2 emission of estimated 259,008 tons annually by shifting to 100,000 electric tricycles (e-trikes).[31] In 2019, the DOE has handed over 272 e-trike units to government agencies and 2,728 units has been given to LGU-recipients in Metro Manila; Laguna, Batangas, Cavite, Bulacan, Ilocos Norte, Isabela, Camarines Sur, Negros Occidental, Romblon, Palawan and Marawi City.[32]

[29] UNEP. *Electric Mobility Projects in Asia and The Pacific*. Accessed January 8, 2022. https://www.unep.org/fr/node/23851.

[30] UNIDO. *Accelerating the adoption and scale-up of electric mobility for low-carbon city development in the Philippines.* (Project information) Accessed February 20, 2022. https://open.unido.org/projects/PH/projects/180210

[31] International Energy Agency. *Market Transformation through Introduction of Energy Efficient Electric Vehicles Project (E-Trike Project)* (Project information) .https://www.iea.org/policies/8717-market-transformation-through-introduction-of-energy-efficient-electric-vehicles-project-e-trike-project.

[32] Manila Bulletin. December 24, 2019. *DOE Completes Distribution Of 3,000 E-Trikes*. https://mb.com.ph/2019/12/24/doe-completes-distribution-of-3000-e-trikes/.

There are also initiatives to commercialize e-mobility technologies, with local government units partnering with research organizations to deploy EVs and charging infrastructure in their respective cities. For example, Dapitan City's "Smart City" initiative received a grant from the DOST-9 to deploy the CharM technology, which enables EVs to be charged in just 30 minutes using a solar photovoltaic hybrid system. This will help promote a cleaner and more efficient transportation sector in the city, paving the way for the wider adoption of e-mobility solutions across the Philippines.[33]

3.2.7 Local Policy Development Scenario

The Philippines is on the path towards becoming a hub for green, new technology, and sustainable manufacturing. Under the Marcos administration's new Science, Technology, and Innovation-driven industrial strategy, the government is actively developing and promoting the EV industry to attract investments in EV assembly, including strategic parts and components such as charging stations, automotive electronics, battery manufacturing, and mineral processing.

As provided for under Section 24 of EVIDA, the government will create a targeted incentives program, similar to the CARS Program, through the EVIS, to attractive huge investments in the sector that would build the domestic EV industry and position the Philippines as a future regional player in the emerging global electric vehicle value chain.

EVIS would support the manufacture of EVs with strong domestic market acceptance, strong manufacturing potential, and promising export opportunity. Specifically, it will support 4-wheeled commercial vehicles, especially e-JP, in support of the PUVMP, and prospectively other EV segments such as electric 2- and 3-wheeled vehicles.

The DTI-BOI is leveraging the country's available resources to support high-value manufacturing activities. For instance, by attracting foreign investments in activities such as mineral processing, the government aims to entice battery and EV manufacturers to set up shop in the Philippines. Furthermore, the government is committed to promoting renewable energy, with a significant portion of investment approvals in this sector.[34]

The country's approach is guided by the four pillars of EV diffusion (Table 10), as identified in the 2019 Philippine EV Policy Analysis Report.[35] These pillars are EV cost reduction, industry development, demand generation, and charging infrastructure development. To generate demand, the government has rolled out various initiatives, including fringe benefits, a government EV procurement program, corporate EV fleet programs, and a minimum EV share for public transport. For manufacturers and assemblers, policies have been established to support importation and supply-side subsidies for EV components.

Additionally, DOE-endorsed energy efficiency projects related to government and corporate EV re-fleeting and operation of shuttle services or fleet leasing can avail fiscal incentives through the DTI-BOI based on DOE DC No. DC 2022-03-0004. A range of fiscal incentives is available through various legislations and policies, making the Philippines an attractive destination for investors in the EV industry.

[33] https://www.pna.gov.ph/articles/1195501

[34] https://mb.com.ph/2023/02/19/promote-green-innovative-manufacturing-to-boost-foreign-investments-pbbm/

[35] Biona, et al. 2019. *Philippine Electric Vehicle Policy Analysis Report - Draft Report. 2019*. https://www.researchgate.net/publication/335464260_Philippine_Electric_Vehicle_Policy_Analysis_Report_-_Draft_Report

Table 10. EV demand generation through national legislation and policies

Policies and Legislations	EV cost reduction	Industry development	Demand generation	Charging infrastructure development	Used battery and power supply management
Executive Order No. 877-A, s. 2010: The Comprehensive Motor Vehicle Development Program					
Executive Order No. 12: Temporarily Modifying the Rates of Import Duty on Electric Vehicles, parts, and components under Section 1611 of Republic Act No. 10863, otherwise known as the "Customs Modernization and Tariff Act"					
Republic Act No. 10963: Tax Reform for Acceleration and Inclusion (TRAIN)					
BOI Memorandum Circular no. 2021-001: 2020 Investment Priorities Plan					
Executive Order No. 182, s. 2015: Comprehensive Automotive Resurgence Strategy Program or "CARS Program"					
Executive Order 226: Omnibus Investment Code					
Executive Order No. 488: Amendment to tariff and customs code of 1978 **for** assembly of alternative fuel vehicles					
Republic Act No. 7916: Special Economic Zone Act of 1995					
Republic Act No. 10771: Philippine Green Jobs Act of 2016					
Republic Act No. 11285: Energy Efficiency and Conservation Act					
Republic Act No. 11534: Corporate Recovery and Tax Incentives for Enterprises (CREATE) Act					
Administrative Order No. 227, s. 2008: Preference in procurement of goods and services from the Philippines					
DOTr Department Order No. 2017-011 : Public Utility Vehicle Modernization Program (PUVMP)					
LTO Administrative Order No. 2021-039: Guidelines for Electric Motor Vehicles					
EVCS Policy Guidelines (DC2021-07-0023)					
Republic Act No. 7718: Amended BOT Law					
Republic Act No. 11234: Energy Virtual One-Stop Shop Act					
Republic Act No. 9513: Renewable Energy Act of 2008					
Green Energy Option Program (DC2018-07-0019)					
Republic Act No. 6969: Toxic Substances and Hazardous and Nuclear Wastes Control Act					
Republic Act No. 9003: Ecological Solid Waste Management Act					
Department Circular No. DC 2022-03-0004: Guidelines for the Endorsement of Energy Efficiency Strategic Investments to the Board of Investments for Fiscal Incentives					

Many of the automobile industry-specific policies generally do not discriminate between ICEV and EV when it comes to providing tax holidays, duty exemptions, and improving ease of doing business. As a result, investments for ICEV are favored over EV because of the former's higher market share, distribution of service centers, and level of development. In contrast, the EV industry is a developing market that would require extensive training, research and development, and market promotion.

Renewable Energy Act of 2008

The Renewable Energy Act of 2008 serves as a crucial enabler of the EVIDA's goal to achieve energy security by harnessing renewable energy sources. One noteworthy provision of the Renewable Energy Act of 2008 is the option for EVCS with high energy demand of 1MW or more to directly contract with renewable energy developers. This paves the way for the adoption of sustainable energy sources and contributes to the reduction of carbon emissions in the industry. The Green Energy Option Program also allows EVCS to source their energy demand from Renewable Energy Suppliers, further promoting the use of cleaner energy sources.

Furthermore, the Renewable Energy Act of 2008 provides incentives for RE facilities that use renewable energy sources for both power and non-power applications. These incentives are granted upon certification by the DOE and include benefits such as income tax holiday, duty-free importation of renewable energy machinery and equipment, and net metering, among others. These incentives can help attract more investors to invest in renewable energy sources in the Philippines and support the country's transition towards a more sustainable future:[36]

- Income tax holiday for seven years;
- Duty-free importation of RE machinery, equipment and materials including control and communication equipment;
- Special realty tax rates on equipment and machinery not exceeding 1.5% of their original cost less accumulated normal depreciation or net book value;
- Net operating loss during the first 3 years of commercial operation which had not been previously deducted from gross income shall be carried over as deduction from gross income for the next 7 consecutive taxable years immediately following the year of such loss (NOLCO);
- Corporate tax rate of 10% on its net taxable income after 7 years of ITH;
- Accelerated depreciation of plant, machinery and equipment may be applied if the project fails to receive an ITH before full operation;
- 0% Value-Added Tax rate on the sale of fuel or power generated from RE sources. Zero rated VAT on purchases of local supply of goods, properties and services needed by RE developers in the development, construction and installation of its plant facility as well as the exploration and development of RE resources and its conversion into power. This will apply for EVCS with RE power source generation;
- Tax exemption on carbon credits;
- Cash incentive of Renewable Energy developers for Missionary Electrification. A cash generation-based incentive per kilowatt hour equivalent to 50% of the universal charge for the power needed to service missionary areas chargeable against the universal charge for missionary electrification;
- Tax credit on domestic capital equipment and services;
- Exemption from universal charge; and
- Option to pay transmission and wheeling charges of on a per kilowatt-hour basis at a cost equivalent to the average per kilowatt-hour rate of all other electricity transmitted through the grid.

Corporate Recovery and Tax Incentives for Enterprises (CREATE) Act

There are also incentives for RBE based on Republic Act No. 11534, otherwise known as the CREATE Act. The Act identifies incentives to RBE activities that are included in the SIPP. SIPP includes EV manufacturing and charging stations, which provide the RBEs with ITH and ED[37] for the registered activities. Furthermore, the CREATE Act provides zero tariffs and customs duty to capital equipment,

[36] https://www.doe.gov.ph/re-developers

[37] Depreciation allowance, labor expenses, R&D expenses, technical training expenses for new hires, domestic input expenses, power expenses, reinvestment allowance for manufacturing industries, and enhanced net operating loss carry over

raw materials, spare parts, or accessories that are directly and exclusively used in these activities. Corporations can also benefit from reductions to their regular corporate income tax and minimum corporate income tax (Table 11, Table 12, Table 13). This Act also encourages the transfer of activities to less developed areas, promoting inclusive economic growth throughout the country.

Table 11. Corporate income tax reduction under CREATE[38]

TYPE OF BUSINESS	CREATE
Domestic MSME corporations with a taxable income of P5M and below, and with total assets of not more than P100M	20%
Domestic corporations which earn a taxable income above P5M	25%
Foreign corporations subject to the regular rate (for nonresident foreign corporations: effective January 1, 2021)	25%
Percentage tax for non-VAT taxpayers (applicable from July 1, 2020 to June 30, 2023)	1%
Minimum corporate income tax (applicable from July 1, 2020 to June 30, 2023)	1%
Foreign-sourced dividends received by domestic corporations	Exempt, subject to reinvestment of earnings in the Philippines

Table 12. Enhanced Deductions under CREATE

PARTICULARS	CREATE
Power expense	150%
Labor expense	150%
Training expense	200%
Research and development	200%
Domestic input expense	150%
Reinvestment allowance to the manufacturing industry	Up to 50% of reinvested profit (within 5 years from time of reinvestment)
Depreciation allowance	10% for buildings, 20% for machinery

[38] https://taxreform.dof.gov.ph/tax-reform-packages/p2-corporate-recovery-and-tax-incentives-for-enterprises-act/

Table 13. Duration of Incentives under CREATE

LOCATION/INDUSTRY TIERS	TIER I	TIER II	TIER III
For Exporters			
NCR	4 ITH + 10 ED/SCIT	5 ITH + 10 ED/SCIT	6 ITH + 10 ED/SCIT
Metropolitan areas or areas contiguous to the NCR	5 ITH + 10 ED/SCIT	6 ITH + 10 ED/SCIT	7 ITH + 10 ED/SCIT
All other areas	6 ITH + 10 ED/SCIT	7 ITH + 10 ED/SCIT	7 ITH + 10 ED/SCIT
For Domestic Market Activities			
NCR	4 ITH + 5 ED	5 ITH + 5 ED	6 ITH + 5 ED
Metropolitan areas or areas contiguous to the NCR	5 ITH + 5 ED	6 ITH + 5 ED	7 ITH + 5 ED
All other areas	6 ITH + 5 ED	7 ITH + 5 ED	7 ITH + 5 ED

Philippine Green Jobs Act of 2016

The Philippine Green Jobs Act of 2016, also known as Republic Act No. 10771, is an important piece of legislation that provides incentives and funding for training and research development in the field of renewable energy. However, despite this, there is still a shortage of human resources with technical competencies in electric vehicles that are necessary to meet the growing demand for EVs. This shortage underscores the need for continued investment in education and training programs in the EV industry.

Further, Republic Act No. 11285, also known as the Energy Efficiency and Conservation Act, provides not only regulation through the Minimum Energy Performance (MEP) but also entitlement to investments. This is in consideration of the Omnibus Investments Code (EO 226) and technical assistance from the government for energy efficiency projects related to EVs. This Act serves as an important complement to the Philippine Green Jobs Act of 2016 by promoting the development of a highly skilled workforce capable of meeting the demands of the EV industry.

Together, these two Acts provide a comprehensive framework for promoting the development of the EV industry in the Philippines. These legislations do not only provide incentives for businesses and investors but also ensure that the necessary human resources and training programs are in place to support this growth.

Executive Order No. 12, series of 2023

Executive Order No. 12 temporarily modifies the rates of import duty on EV, parts, and components under Section 1611 of Republic Act No. 10863, otherwise known as the "Customs Modernization and Tariff Act". The EO 12 will temporarily cut the MFN tariff rates to zero percent on completely built-up units of certain EVs except for HEVs, for a period of five (5) years. Thus, EV adoption can be more competitive to consumers. There are calls for the expansion of EO No. 12 to include incentives for two- and three-wheeled EVs. Such expansion is expected to incentivize Filipinos to make the switch to healthier, cost-effective, and sustainable transportation options[39].

[39] https://businessmirror.com.ph/2023/02/16/palace-urged-to-widen-scope-of-eo-on-ev-tax-incentives/

Metropolitan Manila Development Authority (MMDA) Memorandum

In addition, the MMDA has approved, for non-fiscal incentives, the exemption of EVs from all number-coding schemes. This issuance may attract more EV adoptions particularly in the NCR.

National Transport Policy (NTP)

Through NEDA Board Resolution No. 5, s. 2017, the NTP was approved. The NTP of the Philippines aims to create a sustainable, reliable, and safe transportation system that is accessible to all. The policy is guided by the PDP targets, which set out the government's vision for transport infrastructure and services in the country.

One of the key objectives of the policy is to improve mobility, particularly in urban areas, by reducing travel time and congestion. This is being addressed through the construction of new roads, bridges, and flyovers, as well as the implementation of intelligent transport systems and the use of alternative modes of transportation such as bicycles and walking.

Another priority is to modernize the country's public transport system, which is largely made up of JPs and buses. Section 12 of the IRR of the NTP highlights the need for transport agencies and LGUs to consider environmentally friendly modes of transport that utilize BEVs and HEVs. Moreover, the efficiency of public transport is expected to improve through the introduction of bus rapid transit systems and other mass transit options.

Further, the DOTr in the Philippines has a strategy to promote the use of EVs by creating environmentally friendly transport routes and incentivizing EV deployment. The government plans to increase demand for EVs by implementing low-carbon urban transport systems and mandating the 5% fleet quota for transport operators. The DOTr aims to create a conducive environment for private sector investment in ICT infrastructure, promote the use of EVs, and eliminate bureaucratic processes that delay infrastructure projects.[40]

To address the challenges brought about by the increasing number of motor vehicles in urban areas, the Philippine government launched the Public Utility Vehicle Modernization Program (PUVMP) in 2017. Led by the DOTr, the program seeks to transform the public land transportation industry and provide a safer, more efficient, and reliable mode of public transportation for Filipinos.

Partnerships among players in the private sector are key in the deployment of shuttles. As such, A Brown Company Inc. has partnered with Global Electric Transport Philippines to launch electric shuttle services in Cagayan de Oro City. The joint venture will see the formation of a new company jointly owned by A Brown and GET Philippines, which will initially own ten (10) EVs. The investment amount for the project has not been revealed yet. The joint venture company will be responsible for the management, service, and operation of the electric shuttle service and will offer the vehicles as a marketing tool for third parties. The vehicles will use the GETPASS Transport Ecosystem for fleet and passenger management.[41]

Philippine Development Plan (PDP)

To promote better connectivity between communities and economic opportunities, the development of local road networks is essential to reduce transportation costs. In addition to this, promoting active mobility options and utilizing EVs can further enhance the transportation system.

[40] https://www.bworldonline.com/economy/2023/02/20/505884/electric-vehicle-rollout-strategy-to-incentivize-green-transport-routes/
[41] https://mb.com.ph/2023/02/21/a-brown-seals-tie-up-with-get-ph-for-evs/

In terms of the PDP targets, the government has set a goal of increasing the capacity of the country's airports, seaports, and train stations, and improving their connectivity to other transport modes. The plan also aims to increase the share of public transport in the country's overall transport mix, and to reduce the number of private vehicles on the roads. The specific targets are encompassed in the results matrix for Chapter 12: Expand and Upgrade Infrastructure *(Figure 13)*.

Objectives/ Results	8 Pt. Socio-economic Agenda	SDG Tier 1 Indicators	Indicator	Baseline		Annual Plan Targets						End-of-Plan Target [b]	Means of Verification	Responsible Agency [c]	Reporting Agency [d]	Assumption and Risks
				Year [a]	Value	2023	2024	2025	2026	2027	2028					
Societal Goal																
Economic transformation for a prosperous, inclusive, and resilient society																
Chapter Outcome																
Sustainable, resilient, integrated, and modernized infrastructure facilities and services delivered			Public infrastructure spending increased (% share to Gross Domestic Product or GDP)[e]	Q1-Q3 2022	5.90	5.20	5.10	5.00	5.00	5.40	6.00	6.00	Actual spending	All Concerned Implementing Agencies (IAs)	DBM / DBCC	
Sub-chapter Outcome 1																
Planning, programming, and asset management in infrastructure enhanced																
Sub-chapter Outcome 2																
Seamless and inclusive connectivity achieved (via local and international linkages)		**Physical Connectivity**														
			Travel time (decreased) via land per key corridor (hours)[f]	2021 2019	2.38 3.285	3.272	3.258	3.246	3.233	3.220	3.207	3.207	Agency reports	MMDA/DPWH	MMDA/DPWH	Assumptions: Regular data collection, processing/consolidation, and reporting to NEDA Risks: Delays in the conduct of surveys; lack of disaggregated data per mode
			Percentage of cycling households in the Philippines increased (% of HHs)	2020	29	30.00	31.00	32.00	33.50	35.00	36.00	36.00	Agency reports; Third-party independent surveys	DOTr	DOTr	Assumptions: DOTr as Central Repository of data as per the NTP and its IRR; Regular data collection, processing/consolidation, and reporting to NEDA Risks: Delays in the conduct of surveys; lag in reporting; unreported cases
		9.1.2 Passenger and freight volumes, by mode of transport	Passenger trips via rail in Metro Manila increased (% share to total passenger trips, cumulative)	2021	1.00	11.00	12.00	12.50	13.00	13.50	14.00	14.00	Agency reports	LRMC/LRT1 PMO, LRTA, PNR, DOTr-MRT3	DOTr	Assumptions: DOTr as Central Repository of data as per the NTP and its IRR; Regular data collection, processing/consolidation, and reporting to NEDA Risks: Lag in data reporting by rail authorities and private operator/s
		9.1.2 Passenger and freight volumes, by mode of transport	Passengers transported via air and sea increased (in million passengers, cumulative)	2021	35.72	158.54	166.47	174.79	183.53	192.71	202.34	202.34	Agency reports	CAAP, MIAA, MCIAA,CIAC, DIAA, PPA, CPA,	DOTr	Assumptions: DOTr as Central Repository of data as per the NTP and its IRR; Regular data collection, processing/consolidation, and reporting to NEDA Risks: Lag in data reporting by airlines, shipping line, and port and airport authorities
Seamless and inclusive connectivity achieved (via local and international linkages) (continued)			Cargo transported via air and sea increased (international and domestic) (in million MT, cumulative)	2021	470.30	1,302	1,400	1,470	1,570	1,700	1,850	1,850	Agency reports	CAAP, MIAA, MCIAA,CIAC, DIAA, PPA, CPA, SBMA, Ecozones	DOTr	Assumptions: DOTr as Central Repository of data as per the NTP and its IRR; Regular data collection, processing/consolidation, and reporting to NEDA Risks: Lag in data reporting by airlines, shipping line, and port and airport authorities
			Cargo transported via air and sea increased (international and domestic) (in million MT, cumulative)	2021	470.30	1,302	1,400	1,470	1,570	1,700	1,850	1,850	Agency reports	CAAP, MIAA, MCIAA,CIAC, DIAA, PPA, CPA, SBMA, Ecozones	DOTr	Assumptions: DOTr as Central Repository of data as per the NTP and its IRR; Regular data collection, processing/consolidation, and reporting to NEDA Risks: Lag in data reporting by airlines, shipping line, and port and airport authorities
		3.6.1 Death rate due to road traffic injuries	Road traffic accident (crash) rate reduced (number of incidents per 100,000 population) - incidents of accidents (crash)	2021	3.85	3.50	3.40	3.30	3.00	2.75	2.50	2.50	Vital Statistics Report, PSA	DOTr	DOTr	Assumptions: DOTr as Central Repository of data as per the NTP and its IRR; Regular data collection, processing/consolidation, and reporting to NEDA Risks: Delays in the conduct of surveys; lag in reporting; unreported cases

a. Actual data as of December 2021, or most recent available data.
b. May either be the cumulative or incremental target value at the end of the plan period.
c. Indicate one lead responsible agency only. Said agency shall be responsible for reporting progress on the indicator targets.
d. Lead/responsible agency for reporting progress on indicator targets.
e. Indicative and subject to updating. Projections pertain to disbursements from NG infrastructure, infrastructure subsidy/equity to GOCCs, and transfers to LGUs intended for infrastructure activities. Includes payables from current year's budget and prior years' obligations.
f. Data for Metro Manila only (from MMDA), included pre-pandemic (2019) baseline for better comparison; latest data (2021) is provided for reference

Figure 13. Chapter 12 Results Matrix for Physical Connectivity

Overall, the PDP targets seek to create a more efficient, reliable, and sustainable transportation system in the Philippines. One that will help to support economic growth and development, while also improving the quality of life of the country's citizens.

Philippine Energy Plan (PEP)

The PEP is a comprehensive document that outlines the government's strategies, policies, and programs to achieve the country's energy goals. The PEP aims to provide energy security to the country and to promote the use of clean energy, while reducing the country's dependence on imported fossil fuels. One of the key strategies is to develop indigenous energy resources and increase energy efficiency through energy conservation and demand-side management measures. To promote the use of renewable energy, the PEP includes policies and incentives, such as feed-in tariffs and tax incentives. The plan is regularly updated to reflect changes in the energy landscape and guide the country's energy sector towards a sustainable future. The PEP targets a 35% renewable energy share in the country's total energy mix by 2030.

Moreover, the PEP highlights the required installed capacities by 2040. As such, a total installed capacity of 95.7 GW will be required. This is four times more than the 26.3 GW capacity recorded in 2020. The increased capacity will come from committed and new power generation projects, with about two-thirds of the new capacity (45.6 GW) being from RE sources. The shares of energy sources are as follows:

Table 14. Total Capacity and Additions By Fuel Type (2020-2040) (MW)

Fuel Type	Total Capacity		Capacity Additions				Total Capacity	
	2020		2021-2030		2031-2040		2040	
	Levels	% Shares	Levels	%	Levels	% Shares	Levels	% Shares
Coal	10,944	41.69	2,641	9.23	0	-	13,585	14.2
Natural Gas	3,453	13.15	3,570	12.48	17,240	42.24	24,263	25.36
Oil	4,237	16.14	381	1.33	0	-	4,618	4.83
Renewable	7,617	29.02	22,014	76.96	23,574	57.76	53,205	55.61
Geothermal	1,928	7.35	400	1.40	80	0.20	2,408	2.52
Hydro	3,779	14.40	1,987	6.95	9,660	23.67	15,426	16.12
Wind	443	1.69	772	2.70	812	1.99	2,027	2.12
Solar	1,019	3.88	18,639	65.16	12,932	31.69	32,590	34.07
Biomass	447	1.70	216	0.75	90	0.22	753	0.79
Total	**26,250**	**100**	**28,606**	**100**	**40,814**	**100**	**95,670**	**100**

Solar energy, despite having the lowest capacity factor, is expected to contribute as much as 70 percent of the total renewable capacity addition. By 2040, solar will make up 34.1 percent of the total installed capacity due to its decreasing capital cost and lowest levelized cost of electricity. Other significant contributors to the total installed capacity include natural gas (25.4 percent), hydro (16.1 percent), and coal (14.2 percent), with no new additional coal projects due to the government's coal moratorium. Other technologies such as oil, geothermal, wind, and biomass will provide 1.0 to 5.0 percent of the total installed capacity. The summary of the projected capacities is indicated in **Error! Reference source not found.**15.

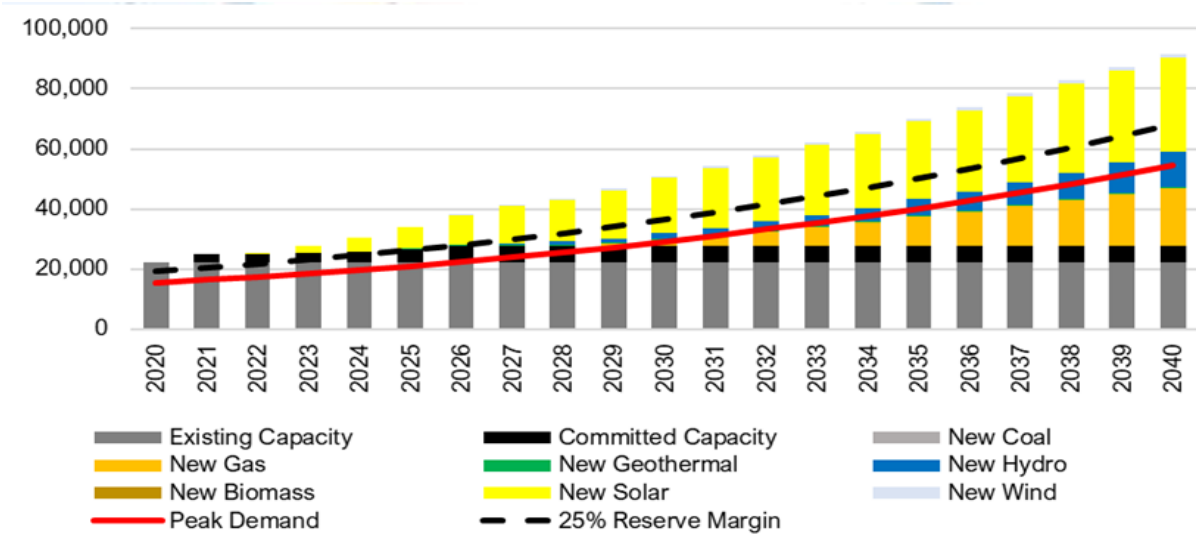


Figure 14. Total Installed Capacity (Existing, Committed, and New Build) (MW), 2021 – 2040
Source: Philippine Energy Plan 2020-2040

3.2.8 Technical Standards, Specifications, Product Quality and Regulatory Framework Local Scenario

Establishing product standards and utilization regulations is crucial in ensuring the safe and efficient operation of EVs, especially in the context of the rapid increase in their use in the Philippines. The DTI-BPS has developed product standards. Table 15 presents a comprehensive list of standards that are for EVs.

Table 15. List of standards relevant for EVs

Examples of standards specific to EVs		
General	PNS UN R 100: 2019	Uniform provisions concerning the approval of vehicles regarding specific requirements for the Electric Power Train
	PNS ISO TR 8713:2021	Electrically propelled road vehicles – Vocabulary
	PNS IEC/TR 60784:2012	Instrumentation for electric road vehicles (retracted by IEC in 2016)
	PNS IEC/TR 60785:2012	Rotating machines for electric road vehicles (retracted by IEC in 2016)
	PNS ISO 8715:2012	Electric road vehicles - Road operating characteristics
	PNS UNR 101:2016	Measurement of the emission of carbon dioxide and fuel consumption and/or the measurement of electric energy consumption and electric range and of categories M1 and N1 vehicles powered by an electric power train only regarding the measurement of electric energy consumption and electric range
	PNS ISO 8714:2012	Electric road vehicles - Reference energy consumption and range - Test procedures for passenger cars and light commercial vehicles
	PNS ISO 6469-4:2018	Electrically propelled road vehicles - Safety specifications - Part 4: Post crash electrical safety
	PNS ISO/TR 13062:2019	Electric mopeds and motorcycles – Terminology and classification
	PNS ISO 13064-1:2019	Battery-electric mopeds and motorcycles – Performance – Part 1: Reference energy consumption and range
	PNS ISO 13064-2:2019	Battery-electric mopeds and motorcycles – Performance – Part 2: Road operating characteristics
	PNS ISO 13063:2019	Electrically propelled mopeds and motorcycles – Safety specifications
Controller	PNS IEC/TR 60786:2012	Controllers for electric road vehicles (retracted by IEC in 2016)

Battery	PNS ISO 12405-3:2018	Electrically propelled road vehicles - Test specification for lithium-ion traction battery packs and systems - - Part 3: Safety performance requirements
	PNS ISO 12405-4:2021	Electrically propelled road vehicles —Test specification for lithium-ion traction battery packs and systems — Part 4: Performance testing
	PNS ISO/IEC PAS 16898:2018	Electrically propelled road vehicles - Dimensions and designation of secondary lithium-ion cells
	PNS ISO 18243:2019	Electrically propelled mopeds and motorcycles - Test specifications and safety requirements for lithium-ion battery systems
	PNS ISO 18300:2018	Electrically propelled vehicles - Test specifications for lithium-ion battery systems combined with lead acid battery or capacitor
Charging Systems	PNS IEC 61851-1:2019	Electric vehicle conductive charging system - Part 1: General requirements
	PNS IEC 61851-21:2012	Electric vehicle conductive charging system - Part 21: Electric vehicle requirements for conductive connection to an AC/DC. supply
	PNS IEC 61851-22:2012	Electric vehicle conductive charging system - Part 22: AC electric vehicle charging station
	PNS IEC 61851-23:2018	Electric vehicle conductive charging system - Part 23: DC electric vehicle charging station
	PNS IEC 61851-24:2018	Electric vehicle conductive charging system - Part 24: Digital communication between a DC EV charging station and an electric vehicle for control of DC charging
EV Connectors	PNS IEC 62196-1:2019	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 1: General requirements
	PNS IEC 62196-2:2019	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 2: Dimensional compatibility and interchangeability requirements for AC pin and contact tube accessories
	PNS IEC 62196-3:2019	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 3: Dimensional compatibility and interchangeability requirements for DC and AC/DC pin and contact-tube vehicle couplers
	PNS IEC/TR 60783:2012	Wiring and connectors for electric road vehicles (retracted by IEC in 2016)
Charge Port	PNS ISO 17409:2018	Electrically propelled road vehicles - Connection to an external electric power supply - Safety requirements
	PNS ISO 18246:2019	Electrically propelled mopeds and motorcycles - Safety requirements for conductive connection to an external electric power supply
Onboard charger	PNS ISO 6469-1:2021	Electrically propelled road vehicles — Safety specifications — Part 1: Rechargeable energy storage system (RESS)
	PNS IEC 61851-21-1:2018	Electric vehicle conductive charging system – Part 21-1: Electric vehicle on-board charger EMC requirements for conductive connection to an AC/DC supply
V2G Network Connectivity	PNS ISO 15118-1:2019	Road vehicles - Vehicle to grid communication interface - Part 1: General information and use-case definition
	PNS ISO 15118-2:2019	Road vehicles - Vehicle to grid communication interface - Part 2: Network and application protocol requirements
	PNS ISO 15118-3:2019	Road vehicles - Vehicle to grid communication interface - Part 3: Physical and data link layer requirements
	PNS ISO 15118-4:2019	Road vehicles - Vehicle to grid communication interface - Part 4: Network and application protocol conformance test
	PNS ISO 15118-5:2019	Road vehicles - Vehicle to grid communication interface - Part 5: Physical and data link layer conformance tests
	PNS ISO 15118-8:2019	Road vehicles - Vehicle to grid communication interface - Part 8: Physical layer and data link layer requirements for wireless communication
Battery Swapping System	PNS IEC TS 62840-1:2019	Electric vehicle battery swap system - Part 1: General and guidance
	PNS IEC TS 62840-2:2019	Electric vehicle battery swap system - Part 2: Safety Requirements
Protection against	PNS ISO 20653:2019	Road vehicles - Degrees of protection (IP code) - Protection of electrical equipment against foreign objects, water, and access

failure modes	PNS IEC 62752:2021	In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD) * (due for adoption)
	PNS ISO 6469-2:2021	Electrically propelled road vehicles - Safety specifications - Part 2: Vehicle operational safety means and protection against failures* (due for adoption)
	PNS ISO 6469-3:2021	Electrically propelled road vehicles - Safety specifications - Part 3: Protection of persons against electric hazards* (due for adoption)
Standards non-specific to EVs but relevant		
Component	**Vehicle Standard**	**Subject**
Controller	PNS ISO 11898-1:2019	Road vehicles - Controller area network (CAN) – Part 1: Data link layer and physical signaling
General	PNS ISO 26262-1:2015	Road vehicles - Functional safety - Part 1: Vocabulary
	PNS ISO 26262-2:2015	Road vehicles - Functional safety - Part 2: Management of functional safety
	PNS ISO 26262-3:2015	Road vehicles - Functional safety - Part 3: Concept phase
	PNS ISO 26262-4:2015	Road vehicles - Functional safety - Part 4: Product development at the system level
	PNS ISO 26262-5:2015	Road vehicles - Functional safety - Part 5: Product development at the hardware level
	PNS ISO 26262-6:2015	Road vehicles - Functional safety - Part 6: Product development at the software level
	PNS ISO 26262-7:2015	Road vehicles - Functional safety - Part 7: Production and operation
	PNS ISO 26262-8:2015	Road vehicles - Functional safety - Part 8: Supporting processes
	PNS ISO 26262-9:2015	Road vehicles - Functional safety - Part 9: Automotive Safety Integrity Level (ASIL)-oriented and safety-oriented analyses
	PNS ISO 26262-10:2015	Road vehicles - Functional safety - Part 10: Guideline on ISO 26262
Standards specific to PUVs		
Vehicle Standards	PNS 2126:2017	Public Utility Vehicles Class 2 and Class 3 - Dimensions
	PNS 2131:2018	Public Utility Vehicles Class 1 - Dimensions

In 2019, a technical working group initiated by the DTI was reconvened comprising of various agencies including the DTI-Competitiveness and Innovation Group, DTI-BOI CARS Program, DOST-MIRDC, DOTr-Land Transportation Office, DOTr-UNDP, DENR, and DOE with the support of EVAP to identify the challenges and opportunities in the development of standards. Challenges are identified in four (4) areas: Development of standards, implementation concerns and regulations, process flow, and absence of in-country testing laboratory.[42]

Overall, the Philippines has adopted many standards related to EVs, but further support regulations, facilities, and expertise must be implemented. The continued development of standards for EVs requires a coordinated effort among key stakeholders to ensure the safe and efficient operation of EVs in the country.

[42] Clean Air Asia and UNEP (draft unpublished). Development of fuel economy and energy efficiency policies in the transport sector in the Philippines.

IV. Challenges that CREVI aims to address

This section provides an overview of the barriers to electric mobility adoption in the country, particularly in the market-side demand, local EV industry, and charging infrastructure industry.

4.1 Challenges in the adoption of EVs

Barriers in market development primarily deal with EVs' reputation from the market players' perspective. Not only is there limited financing aid available, but modern EV technologies are also relatively new and would take time to familiarize with for established industries. The hesitation in adoption then affects the demand for the supporting industries, and technical support only becomes available and active when needed. Likewise, charging or battery-swapping stations and battery disposal procedures can only exist if there is already existing demand for batteries and EVs.

It is crucial to address all cited barriers to ease and incentivize market segments to adopt EVs. Table 16 lists the obstacles in generating sufficient demand for EV adoption. This also shows the degree of significance for each affected vehicle segment.

Table 16. List of barriers to EV market adoption and its level of significance across vehicle segments[43]

Contributing Barrier	Degree of Significance (Low Med High)					
	MC	TC	Car	Van	JP	Bus
A. Market Development						
Flooding concerns		High			Med	
Inadequate or lack of capacity to invest	Low	High			High	
Inferior performance and features compared to conventional units		Med			Med	
Limited availability			Med	High		Med
Higher total investment		High			Med	High
Negative technology reputation		High			High	
Technology skepticism due to lack of familiarity	High	Med	High		Med	High
Technical support doubts	Med	High	High	Low	High	High
Technology inertia	Med	Med	Low	Low	High	Med
B. Technical support						
High spare parts cost due to low demand		High	Med		High	Med
Limited financial capacity of local EV suppliers to stock a large volume of spare parts		High			High	
C. Financing						
Financially high-risk market		High			High	Med
Lack of familiarity with global EV financing services and practices		High	High		High	
Lack of familiarity with technology	Med	Med	Med	Med	Med	Med
Limited government resources	Low	Med		Low	Med	High
Unclear cost-benefit analysis (CBA)	Med	Med	Med	Med	Med	Med
D. Charging/Battery Swapping Services						
Lack of third-party battery leasing/swapping/charging/station providers	High	High	Med	Med	High	Med
Limited operator financial capacity to invest in spare batteries and swapping station		High			High	Med
Varying battery/charging technical requirements	Low	High			High	
E. Battery Disposal						
Lack of knowledge of battery recycling technology	Med	Med	Med		High	High

[43] Trucks are currently not included in the analysis because of these vehicles have steep entry requirements, including expensive high capacity and fast charging batteries. This vehicle segment will be revisited once there are cost competitive options available.

Contributing Barrier	Degree of Significance (Low Med High)					
	MC	TC	Car	Van	JP	Bus
Limited volume to support commercial investments						
Lack of standards and regulations on EV battery reuse						

Note: MC=motorcycle, TC=tricycle, JP=jeepney

4.2 Challenges within the EV industry

Barriers concerning the supply side of the EV industry are primarily focused on the country's currently limited capacity for the manufacturing and assembly of EVs of all types and hindrances to acquiring EV supply parts and batteries. There is an observed lack of local demand for EV manufacturing and assembly. The lack of local EV manufacturing and assembly can be traced to a weak parts and components supply chain and the general low cost-competitiveness and low quantity of locally produced EVs and EV parts. As a result, EV production is transferred to overseas companies with a more established capacity and market share.

Table 17 summarizes these barriers and their significance across vehicle segments.

Table 17. List of barriers to the EV industry and its level of significance across vehicle segments

Contributing Barrier	Degree of Significance (Low Med High)					
	MC	TC	Car	Van	JP	Bus
A. EV Parts or Module Production						
Lack of local EV assembly demand						
Higher power and operating cost						
More established foreign competition						
Weak local parts and components supply chain						
Need for local development and manufacturing of cost-competitive EV parts in higher quantities						
B. Battery Cell Production						
Low purity of nickel reserves						
Foreign control of lithium battery raw material supply						
Lack of local battery cell demand						
High high-pressure acid leach (HPAL) investment cost						
Weak local supply chain						
Higher power and operating cost						
C. Supply or Vehicle Assembly						
Higher power and operating cost						
Lack of access and higher cost of higher quality EV components						
Lack of local demand						
Limited financial capacity to expand production						
Investments too small to meet incentive thresholds						
Strong threat from cheaper imported units						
Limited design flexibility and uneconomical production process due to lack of demand						
Weak local supply chain						

Notes: MC=motorcycle, TC=tricycle, JP=jeepney

4.3 Challenges in the charging infrastructure industry

The Philippines' lack of charging infrastructure has been consistently identified as a major barrier to EV adoption. Firstly, there has been difficulty experienced in attracting investments into charging systems in the country, brought by the lack of an available market. Further, grid and distribution utility investments necessary to support the charging systems are considered high risk due to the lack of available EV charging demand. In addition, the lack of charging standards further increases the investment risk, resulting in the possibility that a larger share of the EV market requires a connector incompatible with the EVCS.

In addition to the lack of charging services, battery leasing and swapping services can only be used by limited vehicle types. These services also have the same concerns and risks as charging services. Thus, necessary support policies must be implemented to mitigate the risks for charging, battery swapping, and battery leasing services to break the causality dilemma.

These issues of limited charging are particularly significant for cars and vans, while limited battery-swapping or leasing services are significant for motorcycles, tricycles, and jeeps. The significant lack of infrastructure to power all vehicle types of all industries contributes to the hesitation in EV adoption. Table 18 presents the issues related to charging and which vehicle types they impact most.

Table 18. List of barriers to the charging industry and its level of significance across vehicle segments

Contributing Barrier	**Degree of Significance** (Low Med High)					
	MC	**TC**	**Car**	**Van**	**JP**	**Bus**
Inadequate demand to attract battery-swapping leasing service providers						
Uncertain/Inadequate demand to attract public charging system investors						
Varying battery systems slow down the attainment of economies of scale						
High charging infrastructure investment cost						
Lack of standard charging protocols						

Notes: MC=motorcycle, TC=tricycle, JP=jeepney

V. Strategic focus areas

The EVs covered by EVIDA include BEV, HEV, PHEV, and LEVs. LEVs cover EVs below 50 kg, including personal mobility devices and e-kick-scooters.

CREVI presents the targets for two scenarios: BAU and CES. For EV charging installations, target adoption numbers are also indicated with the adoption of configuration FF (CCS Combo 2) as the harmonized local charging connector.

CREVI indicates the timeline for compliance with the following: 1) achieve at least a 5% EV share in corporate and government fleets, public transport operators, and industrial and commercial companies at the end year of the Medium Term (2034) and increasing to 10% by 2040; 2) charging station requirements such as dedicated parking slots for EVs and installation of dedicated parking slots with charging stations, and; 3) inclusion in the local government units' development plan, particularly with the identification of the Green Routes in their respective LPTRP. Under the EVIDA, the CREVI is a living plan updated annually by the TWG, and incorporated into the PEP and the NTP.

VI. Comprehensive Roadmap for Electric Vehicle Industry (CREVI) Components – Targets and Strategies

6.1 Roadmap for electric vehicles and charging stations

To facilitate the plan to achieve a specific EV share in the fleet (except for heavy duty vehicles, i.e., trucks) by 2040, the CREVI identifies EV target adoptions.

The CREVI recognizes that the upfront cost parity of EVs with ICEVs will take time. Further, the fiscal position of the country cannot accommodate sustained upfront subsidies similar to those provided in other countries. Thus, the following conditions were set for mandated adoption:

1. Competitive equity requirement,
2. Competitive annual ownership expense throughout the service period, and
3. Competitive total cost of ownership.

The economic impacts and employment calculations for the EV Industry are based on the projected EV adoption by 2040. This was associated with the benefits from the EV investments that include the value of the country's expenditures, primarily related to the construction of EVCS and EV support systems; the value of the vehicle industry stakeholders associated with sales of EV; fuel savings to owners due to the switch from gasoline to electricity; avoided maintenance to owners; and the increase in revenue to generators due to increase of country's electric consumption from electric fueling.

On the other hand, heavy duty vehicles such as trailers, trucks and other similar vehicles for freight transport, are expected to be fitted with fuel cell electric systems. Such system will provide heavy duty vehicles with a longer mileage and a lesser refueling time compared to BEVs[44]. Heavy duty BEVs require more battery packs resulting to heavier gross vehicle weight compared to fuel cell EVs which are typically lighter. Hence, fuel cell EVs are more energy efficient for long travel service and steep incline roads[45].

6.1.1 Business-as-Usual (BAU) Scenario

In the BAU Scenario, it is expected that electric vehicle adoption will reach at least ten percent (10%) of the total fleet by 2040 for all sectors, excluding EV trucks. While this may seem like a modest target, the short-term will be defined by technology upgrading and the scaling up of local EV manufacturing, specifically e-JP and e-TC manufacturing. To achieve this goal, capacity building and technical support initiatives for public transport cooperatives will be prioritized.

In terms of the projected additional energy demand for this scenario, 26.809 MWh energy demand translating to 12.242 MW power requirement would be required by 2040. This may seem like a significant figure, but it is important to consider the environmental benefits of reduced carbon emissions. The adoption of EVs in this scenario is projected to contribute to an estimated 485.41 million tonnes (Mton) of CO2 emissions by 2040 *(Figure 15).*

[44] https://www.greenbiz.com/article/battle-over-electric-vehicles-could-hydrogen-win#:~:text=The%20key%20distinction%20between%20FCEVs,cell%2C%20it%20can%20generate%20energy.

[45] https://www.kimley-horn.com/bev-or-fcev-which-zev-for-your-fleet/

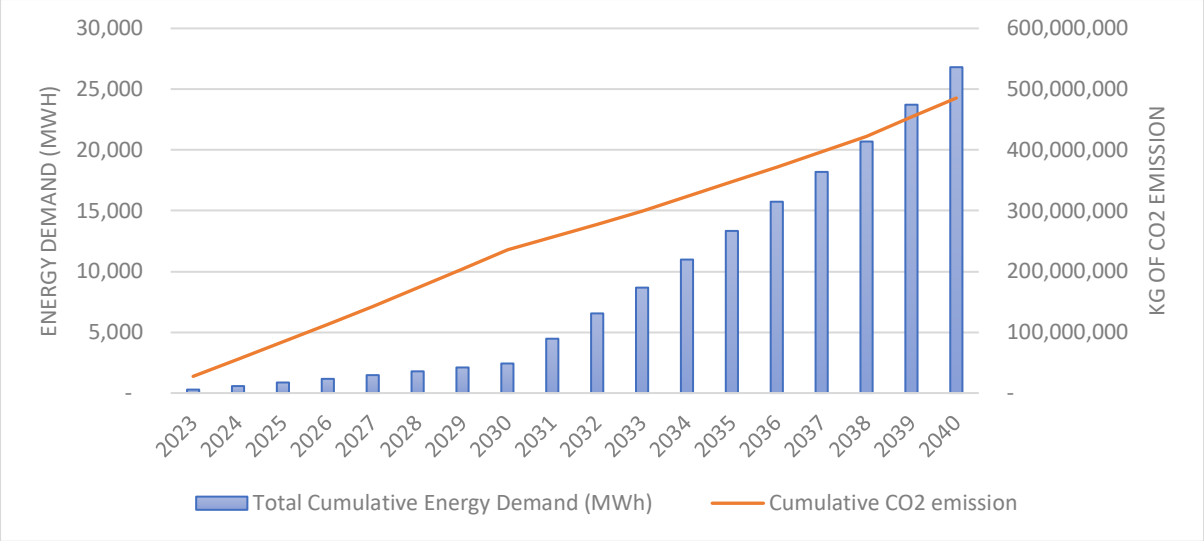


Figure 15. BAU Scenario, Cumulative Energy Demand and CO_2 emission

6.1.2 Clean Energy Scenario (CES)

On the other hand, the CES sets a more ambitious target with the mandated re-fleeting of at least fifty percent (50%) of all fleets with EVs by 2040. This will include all sectors, excluding the household sector. This is further classified as follows:

- Household sector: ten percent (10%) EV share of the total fleet by 2040
- All sector per vehicle type:
  - tricycle/motorcycle: fifty percent (50%) EV share by 2030, sixty percent (60%) by 2040
  - cars/SUV/UV: twenty five percent (25%) EV share by 2030, fifty percent (50%) by 2040
  - bus: ten percent (10%) EV share by 2030, fifteen percent (15%) by 2040

One key factor that is expected to drive the adoption of EVs in the Philippines is the lower upfront cost of tricycle and motorcycle EVs compared to four-wheeled EVs. In addition, these vehicle types are more accessible to consumers and remain the primary choice for transportation across the region *(Figure 16).* This is supported by the fact that this vehicle type accounts for more than 60% of total EV and ICEV vehicle registrations *(Table 1)*. Moreover, existing locally manufactured EVs can be utilized to increase local job opportunities and economic growth.

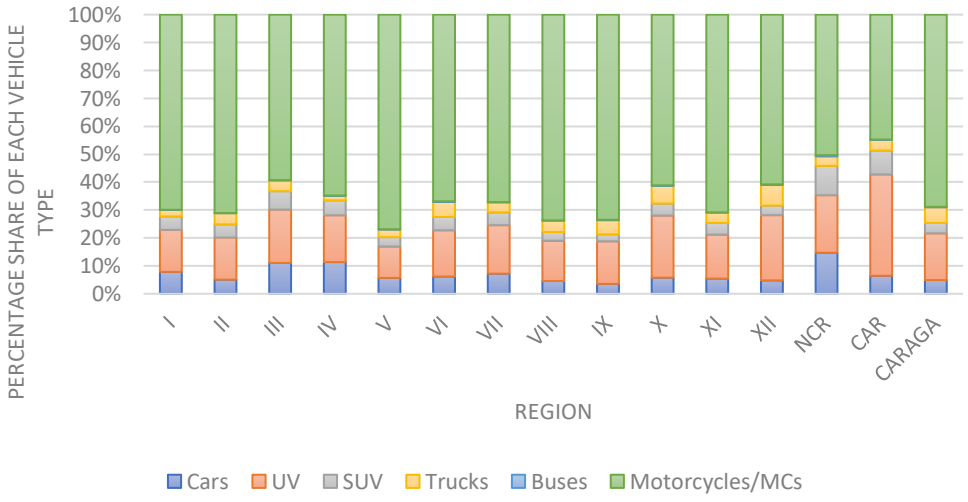


Figure 16. Vehicle type breakdown by region, 2021

For four-wheeled vehicles, HEVs are expected to lead the share of EVs in the short term, while the necessary electric charging infrastructure is being established. It is also anticipated that an increased adoption of BEVs will pick up in the medium to long term.

However, achieving the CES targets will require addressing several barriers, such as the ownership costs, limited availability of technical and aftersales support, technology inertia, and EV-related concerns on the range, performance, and reliability (*Figure 17*). With this public and private partnerships and support will play a crucial role in overcoming these obstacles and creating a conducive environment for the growth of the EV industry.

Despite the projected additional energy demand of 80.162 MWh energy demand translating to 36.604 MW by 2040, the results of the CES target will contribute to a significant reduction in CO2 emissions of 1,963.70 Mton by the same year. These developments present a significant opportunity for the Philippines to improve its environmental sustainability while creating new job opportunities and driving economic growth in the EV industry.

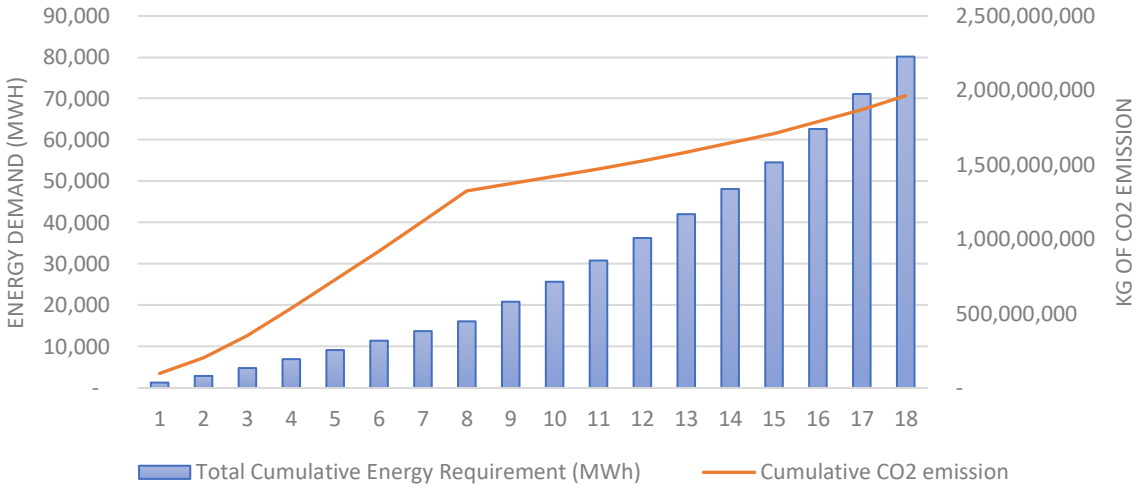


Figure 17. CES, Cumulative Energy Demand and CO_2 emission

6.2 Roadmap for the Electric Vehicle and Charging Stations Development

The goal of this roadmap is to improve the penetration rate of EVs in the country.

6.2.1 Projected Results of the CREVI on Cumulative EV and EVCs inventory by 2040:

Business-as-Usual Scenario : At least ten percent (10%) EV fleet by 2040*

	Short term	Medium Term	Long Term	Grand Total
	2023-2028	2029-2034	2035-2040	
EV Targets	311,700	580,500	850,100	1,744,400
EVCS	7,400	14,000	20,300	41,700

**EV share from the total projected vehicle fleet*

Clean Energy Scenario: At least fifty percent (50%) EV fleet by 2040*

	Short term	Medium Term	Long Term	Grand Total
	2023-2028	2029-2034	2035-2040	
EV Targets	2,454,200	1,851,500	2,001,600	6,306,480
EVCS	65,000	42,000	40,000	147,000

**EV share from the total projected vehicle fleet*

6.2.2 Projected Vehicle Segment per EV Type Adoption by 2040:

Business-as-Usual Scenario : At least ten percent (10%) EV fleet by 2040*

Targets		Short term	Medium Term	Long Term	Grand Total
		2023-2028	2029-2034	2035-2040	
Vehicle Type	EV Type				
Sedan, SUV, UV	HEV	81,500	49,000	36,600	167,100
	PHEV	13,600	24,600	36,600	74,800
	BEV	13,600	123,000	219,400	356,000
Tricycle	BEV	37,500	71,000	103,400	211,900
Motorcycle	BEV	164,900	311,800	454,400	931,100
Bus	BEV	600	1,200	1,800	3,600
Total		**311,700**	**580,600**	**852,200**	**1,744,500**

**EV share from the total projected vehicle fleet*

Clean Energy Scenario: At least fifty percent (50%) EV fleet by 2040*

Targets		Short term	Medium Term	Long Term	Grand Total
		2023-2028	2029-2034	2035-2040	
Vehicle Type	EV Type				
Sedan, SUV, UV	HEV	415,000	234,000	107,000	756,000
	PHEV	69,000	80,000	107,000	256,000
	BEV	69,000	327,000	641,000	1,037,000
Tricycle	BEV	419,000	262,000	223,000	904,000
Motorcycle	BEV	1,480,000	947,000	922,000	3,349,000
Bus	BEV	2,200	1,500	1,600	5,300
Total		**2,454,200**	**1,851,500**	**2,001,600**	**6,307,300**

**EV share from the total projected vehicle fleet*

6.2.3 Projected Number of EVCS deployment by 2040

Business-as-Usual Scenario : At least ten percent (10%) EV fleet by 2040*

	Short term	Medium Term	Long Term	Grand Total
	2023-2028	2029-2034	2035-2040	
EVCS**	600	1,200	1,800	3,600
BSS	6,700	12,800	18,600	38,100

**EV share from the total projected vehicle fleet*
***Projected number of EVCS (Mode 4)*

Clean Energy Scenario: At least fifty percent (50%) EV fleet by 2040*

	Short term	Medium Term	Long Term	Grand Total
	2023-2028	2029-2034	2035-2040	
EVCS**	2,200	1,500	1,600	5,300
BSS	64,300	40,300	38,200	142,800

**EV share from the total projected vehicle fleet*
***Projected number of EVCS (Mode 4)*

6.2.4 Financial Requirement Target for Corporate and Government Mandate (in billions of pesos)

Business-as-Usual Scenario : At least ten percent (10%) EV fleet by 2040*

	Total Investment Requirements per Term			Grand Total
	Short term 2023-2028	Medium Term 2029-2034	Long Term 2035-2040	
Government	1.01	2.27	4.58	7.86
Corporate	175.47	480.89	883.72	1,540.08

**EV share from the total projected vehicle fleet*

Clean Energy Scenario: At least fifty percent (50%) EV fleet by 2040

	Total Investment Requirements per Term			Grand Total
	Short term 2023-2028	Medium Term 2029-2034	Long Term 2035-2040	
Government	7.12	9.75	13.68	30.55
Corporate	1,530.62	2,125.89	3,077.87	6,734.38

**EV share from the total projected vehicle fleet*

6.2.5 Projected Cumulative Power Requirements and Carbon Dioxide Emission Avoidance by 2040

Business-as-Usual Scenario : At least ten percent (10%) EV fleet by 2040*

	Short term	Medium Term	Long Term
	2023-2028	2029-2034	2035-2040
Power Requirements (MW)	0.815	5.014	12.242
CO_2 emission (Mton of CO_2)	144.75	323.28	485.41

**EV share from the total projected vehicle fleet*

Clean Energy Scenario: At least fifty percent (50%) EV fleet by 2040*

	Short term	Medium Term	Long Term
	2023-2028	2029-2034	2035-2040
Power Requirements (MW)	5.222	16.563	36.604
CO_2 emission (Mton of CO_2)	939.44	1,525.83	1,963.70

**EV share from the total projected vehicle fleet*

6.2.6 Projected Green Job Generations by 2040

Business-as-Usual Scenario : At least ten percent (10%) EV fleet by 2040*

	Short term	Medium Term	Long Term
	2023-2028	2029-2034	2035-2040
Job Gains	7,800	14,500	21,200
Job Losses	1,200	2,200	3,200
Net Growth	6,600	12,300	18,000

**EV share from the total projected vehicle fleet*

Clean Energy Scenario: At least fifty percent (50%) EV fleet by 2040*

	Short term	Medium Term	Long Term
	2023-2028	2029-2034	2035-2040
Job Gains	61,115	46,100	49,842
Job Losses	9,261	6,987	7,555
Net Growth	51,854	39,113	42,287

**EV share from the total projected vehicle fleet*

6.2.7 Committed Renewable Energy Share by 2040

	Short term	Medium Term	Long Term*
	2023-2028	2029-2034	2035-2040
Business-as-Usual Scenario RE Share (MW)	0.163	2.507	12.242
Clean Energy Scenario RE Share (MW)	1.044	8.281	36.604

**100% RE Share*

6.3 Roadmap for the manufacturing, human resource development, and Research and development

The following initiatives will be carried out to ensure the EV industry's readiness to execute the agreed CREVI. The principles of responsibility and accountability in each key player's performance are integrated in their assigned tasks including the levels of engagement defined at the start of the roadmap implementation. The CREVI will be regularly reviewed and updated when measured against the target results of the action plans and as deemed necessary by the key stakeholders.

Table 19. CREVI Action Plans

Key result area	Responsible Stakeholders and Agencies	Short term (2023-2028)	Medium Term (2029-2034)	Long Term (2035-2040)
6.3.1 Phased Approach to Improve EV utilization		Adopt a phased approach to develop its EV industry to balance industry growth and efforts to grow the market.		
		Ensure demand, provide innovative incentives, introduce required technical regulations and standards, and ensure technology competitiveness of the local industry.		
Demonstration and deployment of EVs	DOTr, DPWH, LGUs, Corporate/Private Sector, DOE, DILG	Rollout pilot programs for government or private sector led on EV and EVCS use		
	All government agencies and Corporate/Private Sector		Deploy EVs and EVCS	
Refleeting of vehicles for government and the private sector	All government agencies and Corporate/Private Sector	Implement EV refleeting and EVCS programs as mandated by CREVI for the public and private sector		
Monitoring of EV refleeting mandates	All government agencies, Corporate/Private Sector	Continue monitoring and enforcing refleeting mandates through existing mechanisms under RA 11285 and RA 11967		
Promote the use of EV and EVCS	DOE, DTI, DOTr	Support EV rental/leasing or sharing programs for affordability of e-mobility		
	DOE, DTI, DOTr	Develop and disseminate IEC Campaign materials to highlight benefits and performance of EVs		

Key result area	Responsible Stakeholders and Agencies	Short term (2023-2028)	Medium Term (2029-2034)	Long Term (2035-2040)
	DOTr, DTI, DOE	Revitalized implementation of the PUVMP to generate reliable and sufficient demand for EV manufacturing, consistent with the EVIS		
6.3.2 Improve the Competitiveness of EV Manufacturing		Improve access to the needed processes, parts and components, expertise and technology, and adopt shared platforms and partnerships.		
Improved Manufacturing capability of the Philippines	DTI, DOST, DOTr	Strengthen and expand manufacturing hubs for 2- and 3-wheeled EVs for domestic markets		
	DTI, DOST, DOTr, NEDA		Support Manufacturing for 2- and 3-wheeled vehicles for international markets	
	DTI, DOST, DOTr, DOE		Strengthen and expand manufacturing hubs for 4-wheeled EVs for domestic markets through EVIS	
	DTI, DOST, DOTr, NEDA			Support Manufacturing for 4-wheeled EV for the domestic market
	DTI, DOST, DOTr, DOLE	Support Manufacturing for EVCS and its components for domestic markets		
	DTI, DOST, DOTr, DOLE, NEDA		Support Manufacturing for EVCS and its components for international markets	

Key result area	Responsible Stakeholders and Agencies	Short term (2023-2028)	Medium Term (2029-2034)	Long Term (2035-2040)
	DTI, DOST, NEDA	Attract foreign investments for export-oriented activities in EV parts and components		
Pilot programs for local manufacturing of EV and EVCS parts and components	DTI, DOST, DOTr, DOLE, NEDA	Support manufacturing and production of batteries for EVs leveraging locally available green metals		
	DTI, DOST	Support and commercialize technologies on EV electronics		
	DTI, DOST, DOTr, DOLE, DOE, DENR	Support and commercialize technologies for mineral refining to purify nickel reserves and other minerals for battery production		
	DTI, DOST, DOTr, NEDA	Conduct pilot programs for EV battery manufacturing		
6.3.3 Research and Development		Prepare the readiness of an electrified and cleaner transport system through research and development of EV and EVCS critical parts and components and the utilization of clean energy sources in the operation of EV ecosystem		
Battery Storage	DOST, DTI, DOE, EV stakeholders	Conduct research and viable studies on battery storage to ensure efficiency and cost effectiveness		
	DOST, DTI, DOE, EV stakeholders		Commercialize battery storage	

Key result area	Responsible Stakeholders and Agencies	Short term (2023-2028)	Medium Term (2029-2034)	Long Term (2035-2040)
Battery Manufacturing	DOST, DTI, DOE, DENR, EV stakeholders	Conduct research on alternative battery components		
	DOST, DTI, DOE, DENR, EV stakeholders		Commercialize the utilization of indigenous minerals for alternative battery component production	
EV Manufacturing	DOST, DTI, DOE, DOTr, EV stakeholders	Conduct research and viable studies for technologies for manufacturing rail, air, and sea transport electric vehicles		
	DOST, DTI, DOE, DOTr, EV stakeholders		Commercialize the adoption of electrified transport system in rail, air, and sea transport	
	DOST, DTI, DOE, EV stakeholders	Conduct research to develop locally available lightweight and high strength materials for EV frames, components and parts		
	DOST, DTI, DOE, DOTr, EV stakeholders		Commercialize the utilization of locally available lightweight and high strength materials for EV	
6.3.4 Human Resource Development		Prepare and capacitate the EV Industry through support technical programs and trainings to ensure ready support services for EV and EVCS operation, maintenance, repair, emergency response and among others.		
Capacity Building for EV and EVCs manufacturing and maintenance	TESDA, DOST, DTI, NEDA	Strengthen/Expand and implement training and educational standards for EV Maintenance and Manufacturing		

Key result area	Responsible Stakeholders and Agencies	Short term (2023-2028)	Medium Term (2029-2034)	Long Term (2035-2040)
Promote entrepreneurial models for the local businesses in the local EV supply chain	DTI, LGUs, DOST, DENR, DOLE, NEDA	Conduct training and shared services facilities for business owners, cooperative or groups with collective action and professionals with successful models of enterprises in the EV supply chain (from supply to after sales service)		
	DOLE, TESDA, DTI	Conduct training for vehicle rental/sharing business models		
	DOLE, TESDA, DOST, DTI, DOTr, DOE	Develop standards and safety practices for EV conversion		
	DOLE, TESDA, DOE, DOTr	Train workers for EVCS operation, maintenance and installation		
	DOLE, TESDA, DTI, DOE, DENR	Develop of standards and safety practices/application for EV battery recycling		
	DOLE, TESDA, DTI, DOE, DENR	Train workers for EV waste management (eg. battery recycling)		
	DOLE, TESDA, DOE, DPWH, DTI	Develop guidelines to perform EV and EVCS inspections based on mandated quality and safety standards		
Capacity Building of the deployment of EVs and EVCs at the local level	All government agencies including LGUs, NGOs, CDA	Conduct training programs for the private and public sectors, NGO and cooperatives for EV and EVCS deployment		

Key result area	Responsible Stakeholders and Agencies	Short term (2023-2028)	Medium Term (2029-2034)	Long Term (2035-2040)
Delivery of efficient and safe technical support services	DOLE, TESDA, DTI, DOE, DOTr	Train and certify personnel for safety servicing of EV and EVCS		
	DOLE, TESDA, DTI, DOE, DOTr		Strengthen/Expand services shops to cater EV maintenance and repair	
International Partnerships	DOE, DOST, DTI, DOTr, NEDA	Conduct knowledge exchange programs and from countries that have EV deployment and develop partnerships for technical capacity building		
6.3.5 Policy and Credit		Implement technical regulations geared towards ensuring the harmonized adoption, sustainable operation, energy efficiency, quality and safety, accessible investments of EVs and EVCS supplied and manufactured to the public.		
Integrate EVCS with clean energy sources	DOE, DTI, DILG, DPWH, LGUs, NEDA	Encourage the utilization of renewable energy sources to power EVCS		
	DOE, DTI, DILG, DPWH, LGUs, NEDA		Mandate 50% utilization of renewable energy sources to power EVCS	
	DOE, DTI, DILG, DPWH, LGUs, NEDA			Mandate 100% utilization of renewable energy sources to power EVCS
Align the EVIS with the priority targets of the CREVI	DTI, NEDA, DOF	Issue EVIS and supporting policies to provide incentives for EVs and EVCs	Implement and enforce of issuances	
Standardization of EVCS and EV	DOE, DOTr, DTI, ERC	Issue relevant policies for EVCS and EV classification including		

Key result area	Responsible Stakeholders and Agencies	Short term (2023-2028)	Medium Term (2029-2034)	Long Term (2035-2040)
		but not limited to minimum energy performance, labelling, safety, and quality		
	DOE, EV stakeholders	Standardization and harmonization of charging protocol of EVCS		
	All government agencies/ offices	Adopt PNS or use as references in formulating policies related to EVs and EVCS for government		
Standardization EVCS Installation/Construction	DPWH, DOE, DILG, LGU	Issue uniform policies on issuance of permits and construction and installation for EVCS		
Open and Public Data for EVCs and EV	DOE, DOTr, DICT, DTI	Develop a uniform database for EVCS and EV data that is accessible to the public observing common APIs to integrate the internet of things for the EV industry	Implement and enforce of issuances	
Implement Fiscal and Non-Fiscal Incentives	BOI, DTI, DOTr, DILG, LGUs, DOF, BIR, BOC, NEDA	Continue implementation/ imposition of additional incentives for EVCS and EV manufacturing		
Strengthening of Government Agencies Concerned	DOE, DOTr, LGUs, DBM	Support strengthening and capacity building for government agencies		
Promote utilization of EVs in the locality and tourism sector	DOE, DOTr, LGUs, DILG, DOT, DPWH, MMDA, NEDA	Issue relevant policies for the adoption of EVs including but not limited to dedicated parking		

Key result area	Responsible Stakeholders and Agencies	Short term (2023-2028)	Medium Term (2029-2034)	Long Term (2035-2040)
		slots, loading and unloading stations for EVs, segregated lanes for LEVs and green routes, fast charge networks for major thoroughfares/highways.		
Research Agenda	DOST, DOE, DOTr, DTI, DENR, DILG, DPWH, NEDA	Development of research agenda for the development of EV and EVCS critical parts and components.		
Financing Support	LGUs, GFIs, BSP, NEDA	Continue and formulate financing models to support EV and EVCS stakeholders		
Waste Management, Recycling, and Reuse of ICE vehicles and EVs	DOST, DENR, DTI, LTO	Issue policies on recycling/reusing ICE vehicles and EVs and their components through EV conversion kits, retrofitting, and other initiatives to promote a circular economy	Implement and enforce of issuances	
Transport policy	DOTr, DTI, DOE, DILG, LGUs	Integrate transport policy with industrial policy to ensure a concerted and coordinated effort in generating demand that can be leveraged by manufacturers to boost domestic production and export EVs		

Annex

A.1 Methodology Used for the CREVI 2023-2040

In formulating the projections, various energy modeling methodologies and tools were used to come up with energy demand and supply projections for the 2023-2040 period. Final energy consumption was projected using a simple projection system, an add-in application in Microsoft Excel. To further improve the energy demand forecasts, sectoral roadmaps including relevant factors and information that impact the projections were considered in the simulation, specifically:

- For the government, household, and corporate sectors, trends and baseline information in the number of LTO registrations and vehicle industry sales for both ICE and EV were considered. This covered yearly data from 2014 to 2022.
- Projections included expansion plans and new projects/programs of the TWG members and other government agencies including DPWH, DOST, DTI, DOTr, NEDA, DBM, and DOF.
- In identifying various EV types, the least cost and high impact options were selected. Among the considerations were the following costs and battery capacity of available EVs:

Table 20. Key Assumptions and considerations for the CREVI Targets

Vehicle type	**Vehicle Price** (PHP)	**Battery Capacity** (kWh)	**Energy Economy** (km/kWh)	**CO_2 emission** (kg CO_2/L, kg CO_2/kWh)
HEV	₱1,800,000.00	1.5	2.25	2.52
PHEV	₱3,000,000.00	15	5.05	2.52
BEV	₱3,000,000.00	60	7.53	0.7
e-TC	₱350,000.00	3	13.48	0.7
e-MC	₱190,000.00	3	28.08	0.7
e-bus	₱25,000,000.00	250	0.8	0.7

- Moreover, the following vehicle types were considered in the EV projections:

EV Type	**Car type**
HEV	Cars (i.e., sedan), SUV, UV
PHEV	Cars (i.e., sedan), SUV, UV
BEV	Cars (i.e., sedan), SUV, UV
e-TC	TC
e-MC	MC
e-bus	Bus

- Power demand was based on the battery capacity (*Table* 20) per EV type with the assumption that EV will charge at a 0% state-of-charge charging to full charge battery, covering a daily mileage of 40 km for all EV type except for e-bus with 100 km per day.
- Vehicle growth rate was assumed to have five percent (5%) annually and scrappage rate of three percent (3%) which is equivalent to a net vehicle growth rate of two percent (2%).

A.2 Notes on Micro-Mobility and Active Transportation

According to a recent survey[46] conducted in the Philippines, bicycle ownership is more common than car ownership, with a ratio of 5:1 in the National Capital Region. This presents a significant opportunity for the country to promote active transport and reduce carbon emissions. Cycling households have increased to 7.3 million as of April 2022, with 3 out of 10 households being cycling households. Many household heads believe that cycling is as effective as other modes of transportation, and the majority agree that more people would use bicycles if the roads were safer. This shows that there is a demand for safer cycling infrastructure in the Philippines.

To support active transport and promote safe use during and after the COVID-19 pandemic, the DOH, the DOTr, the DILG, and the DPWH have signed a Joint Administrative Order (JAO) entitled "Guidelines on the Proper Use and Promotion of Active Transport During and After the COVID-19 Pandemic." The JAO presents an opportunity for national government agencies and local government units (LGUs) to create infrastructure that supports active transport, such as bicycle lanes and walking paths, along with support facilities like bicycle racks and changing rooms. This presents a significant opportunity for LGUs to promote active transport and create a more sustainable future for their constituents.

As oil prices continue to rise, many people in the Philippines are turning to electric kick scooters as an alternative mode of transportation. However, safety concerns have been raised, prompting the MMDA to issue reminders to ensure the safety of those using these vehicles. The maximum speed limit is 12.5 kilometers per hour, and users must wear protective gear and use designated road lanes. Those who use national roads or main thoroughfares like EDSA must use bike lanes or the outermost lane if there are no bike lanes. There are currently approximately 23,000 electric kick scooter users in the Philippines[47], with 85% of them located in the capital region. This presents an opportunity for the government to regulate the use of electric kick scooters and create an infrastructure that supports their safe use.

There is growing interest in active transport and micro-mobility in the Philippines with the rise of bicycles and electric kick scooter use. With the growing number of cycling households, there is an opportunity to create safer spaces for cyclists and provide supportive infrastructure for micro-mobility.

A.3 Notes on Electric Vehicles Incentive Strategy (EVIS)

The Philippines is poised to take advantage of the global shift towards electric vehicles (EVs). The DTI through BOI is formulating an EVIS through pilot activities. These initiatives aim to attract EV and EV parts manufacturing by aligning with existing trends and opportunities such as the country's potential for exports, the declining cost of lithium batteries, the market for logistics, and the need for environment-friendly units.

With this, a pilot initiative is being developed with an initial focus on the local manufacturing of electric commercial vehicles, specifically 4-wheelers, with a production target of 65,000 units. The pilot phase will involve a maximum of 10 cooperatives producing 150 units of Class 1 or 2 vehicles, with a business operation duration of 12 months. The manufacturing roll-out phase aims to produce 7,000-8,000 units annually, with a target of 60% local content that includes the body and locally assembled batteries. To

[46] https://www.bworldonline.com/sparkup/2022/08/25/470529/1-in-4-filipino-households-own-bikes-sws/

[47] https://www.gmanetwork.com/news/topstories/metro/834585/electric-kick-scooters-on-edsa-what-riders-should-know/story/

ensure the success of the program, the government is currently securing funding and finalizing the engagement of the pilot participants.

This presents significant opportunities for the Philippines, particularly in terms of EV exports. However, the success of the program will depend on proper execution and alignment of government efforts. With the government's commitment to sustainable development, the EVIDA has the potential to drive significant economic and environmental benefits for the country.

A.4 Notes on Public Utility Vehicle Modernization Program (PUVMP)

The PUVMP does not only focus on vehicle modernization but also paves the way for a comprehensive approach to reform and consolidate the industry. The program's goals include modernizing the current PUV fleet, improving and rationalizing public transport routes, promoting low-emission PUVs, encouraging modal shift, and enhancing the welfare of commuters, drivers, operators, and their families. The program is composed of other components such as: regulatory reform, local public transport route planning, industry consolidation, and communication.

As of February 2023, the PUVMP has modernized 6,814 PUVs, including UVs and PUJs. The said PUVs are composed of 375 EVs that cover 27 routes in the country. This shift towards the use of EVs is a significant stride towards a more eco-friendly and sustainable future for the Philippines.[48]

The PUVMP presents opportunities for the EV industry in the Philippines, specifically for fleet modernization. With the government's push for low-emission PUVs, EV manufacturers and distributors can take advantage of the potential demand for sustainable and eco-friendly PUVs. The program also provides financing and stakeholder support mechanisms that can benefit players in the EV industry.

A.5 Notes on Cost Ownership of EVs

Total cost of ownership (TCO) analysis is an essential tool for determining the viability of EVs compared to ICEVs. TCO takes into account all the costs incurred by the owner of the vehicle throughout its life, including purchase price, fuel or energy costs, maintenance, and repair costs, among others. In general, the purchase price of an EV is higher than that of an ICEV, but the lower operating costs over the vehicle's life can offset this initial cost.

However, the operational efficiency of EVs depends on several factors, such as the driver's behavior, traffic, vehicle auxiliary/accessory operations, battery quality, etc. Therefore, a sensitivity analysis is necessary to understand under what conditions EVs become a viable option for a specific market segment. The analysis provides a specific threshold value in terms of distance traveled, by which the TCO of an EV is comparable to its conventional equivalent.

In comparison to ICEVs, it can perceive that EVs are more efficient with the average fuel consumption as provided in Table 21. EVs has an average fuel consumption of 6 km/kWh which can be translated to ~Php 1.83/km (~Php 11.00 per kWh = electricity rate) compared to ICEV that has an average fuel consumption of ~14 km/liter[49] of gasoline equivalent, LGe or which can be translated to ~Php 5.00/km

[48] DOTr-LTFRB, Implementation and Monitoring of the PUVMP as of January 2023

[49] ASEAN Fuel Economy Roadmap for the Transport Sector 2018-2025: with Focus on Light Duty Vehicles

(~Php 70.00 per liter of gasoline = average gasoline price). It was also compared that HEVs were ~28% more efficient than ICEVs[50].

Table 21. Vehicle Average Fuel Economy ICEV vs HEV vs BEV

	Internal Combustion Engine Vehicle (ICEV)	Hybrid Electric Vehicle (HEV)	Battery/Pure Electric Vehicle (BEV/PEV)
Average Estimated Fuel consumption	14 km/L	20 km/L	6 km/kWh
Equivalent Estimated Pesos per kilometer	PHP 5.00/km*	PHP 3.50/km	PHP 1.83/km**
Fuel consumption per 100 km	7.14 L/100 km	5.00 L/100 km	-
Fuel avoided per 100 km	-	2.14 L/100 km	7.14 L/100 km

**Average gasoline price PHP 70.00 per liter of gasoline*
***Average electricity rate PHP 11.00 per kWh*

To facilitate the estimation of operating expenses, power and fuel cost calculations are done with the assumption that there is an annual inflation of 3%. In addition, future costs of power and fuel are dependent on the projected prices based on market studies. Further, power costs are calculated at a fixed energy mix of 21% natural gas, 42% coal, 11% oil, and balance RE to simplify the model. The given value of MARR is 0% since this computation is observing a soft-loan scenario.

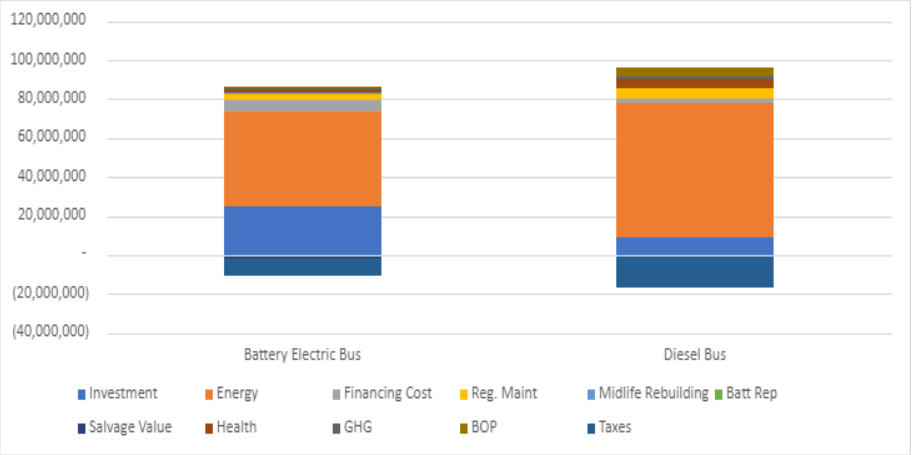
[50] Seyed Amir H. Zahabi, 2014, Fuel economy of hybrid-electric versus conventional gasoline vehicles in real-world conditions: A case study of cold cities in Quebec, Canada, https://doi.org/10.1016/j.trd.2014.07.007

Table 22. Cost-benefit analysis of electric vehicle: total cost of ownership aspect

- 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

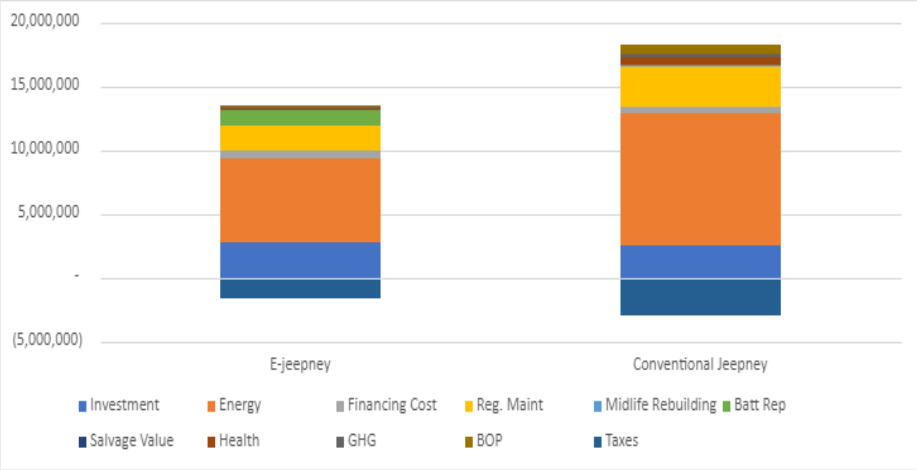
Notes: BEB=battery electric bus, Reg. Maint=regular maintenance, Batt Rep=battery repair, GHG=greenhouse gas, BOP=balance of payments, NPV=net present value. Assumption



- 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

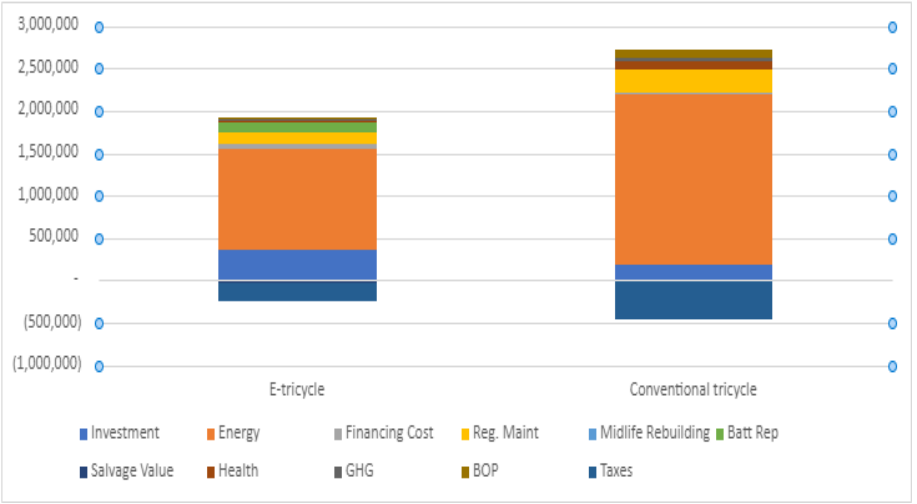
Notes: Reg. Maint=regular maintenance, Batt Rep=battery repair, GHG=greenhouse gas, BOP=balance of payments, NPV=net present value



- E-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

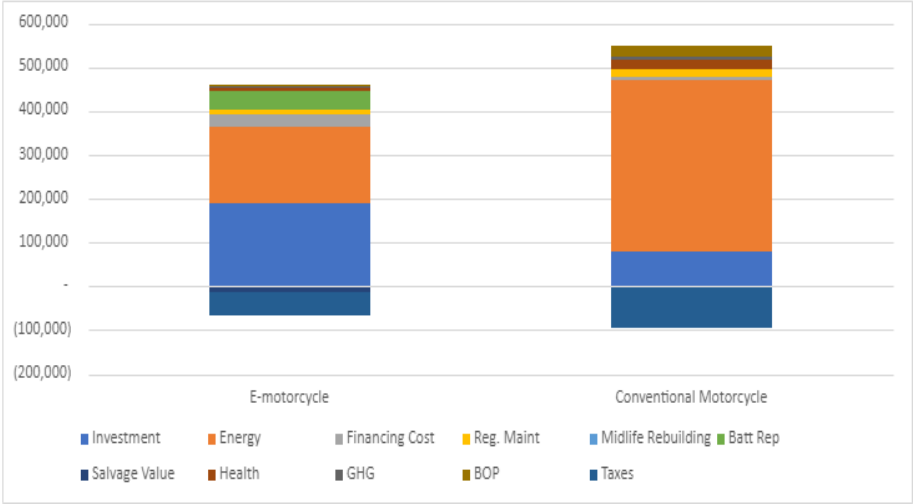
Notes: e-TC=electric tricycle, Con TC=conventional tricycle, Reg. Maint=regular maintenance, Batt Rep=battery repair, GHG=greenhouse gas, BOP=balance of payments, NPV=net present value



- E-motorcycle (e-MC)

Cost Item	e-MC	Conventional MC	Savings
Investment	190,000.00	77,900.00	-112,100.00
Energy	175,856.05	391,769.06	215,913.01
Financing Cost	27,560.04	9,442.57	-18,117.46
Reg. Maintenance	9,513.23	15,397.49	5,884.26
Midlife Rebuilding	-	-	-
Batt Rep	44,000.00	-	-44,000.00
Salvage Value	-11,700.00	-3,895.00	7,805.00
Financial NPV	435,229.31	490,614.12	55,384.81
Health	5,729.47	21,962.50	16,233.03
GHG	3,407.71	8,425.79	5,018.09
BOP	2,925.98	23,475.64	20,549.66
Taxes	-52,973.29	-91,971.83	-38,998.54
Economic NPV	394,319.18	452,506.22	58,187.05

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



- E-cars

Cost Item	E-car	Conventional Car	Savings
Investment	1,900,900.00	851,900.00	-1,049,000.00
Energy	1,676,753.29	5,603,484.13	3,926,730.84
Financing Cost	463,880.08	175,591.08	-288,288.99
Reg. Maintenance	488,749.51	582,884.87	94,135.36
Midlife Rebuilding	46,757.34	31,431.89	-15,325.46
Batt Rep	179,000.00	-	-179,000.00
Salvage Value	-95,045.00	-42,595.00	52,450.00
Financial NPV	4,660,995.22	7,202,696.97	2,541,701.75
Health	48,365.32	296,931.66	248,566.34
GHG	28,794.98	113,916.18	85,121.20
BOP	26,372.54	308,978.13	282,605.59
Taxes	-531,108.38	-1,260,034.89	-728,926.51
Economic NPV	4,233,419.68	6,662,488.05	2,429,068.37

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