Public Transportation Energy Estimation of Scenarios based on the PUV Modernization Plan

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Abstract: The study aimed at identifying the effects of the implementation of the Public Utility Vehicle Modernization Plan (PUVMP) through the comparison of the current and future public transportation system once the modernization program has been implemented. More specifically, the researchers aimed to estimate the total fuel consumption before and after the implementation of the PUVMP and to characterize and identify factors affecting this. Five (5) cities and municipalities were considered as case studies. There is clear indication that energy consumption for the public transportation sector would depend largely on the policies and plans of the different LGUs. Due to limited information on the plans of the 5 LGUs with respect to PUV modernization program of the government, it is not clear whether many LGUs will follow the use of electric vehicles for their public transportation. The city of Ormoc, for instance, is following this path and based on its plan, despite the expected increase in the number of public transport vehicles, there is significant reduction in fuel consumption and increase in fuel efficiency due to the shift to electric vehicles.

Keywords: Energy impact, public utility vehicles

1. INTRODUCTION

Among the major components of the Public Utility Vehicle Modernization Program (PUVMP) is fleet modernization. New vehicle standards are being developed based on consultations among government agencies, jeepney associations and local and international manufacturers. The modern PUVs are intended to be environment-friendly, safe, secure and convenient with due consideration to Persons-with-Disabilities (PWDs) passengers. The PUVMP also encourages industry consolidation or the strategic merging of smaller transport industry players to form into a consortium either by forming cooperatives or corporations. The PUVMP likewise adopts a Vehicle Useful Life Program which consists of policies and programs that deal with different stages of the vehicle’s useful life. This includes the provision of a Motor Vehicle Type Approval System for new vehicles, maintenance programs and improvement of Motor Vehicle Inspection System and a Scrappage Program for end-of-life vehicles.

The current public transportation system relies heavily on public utility jeepneys utilizing fossilized fuel. A modal shift to electric vehicles may have significant change in our dependence on imported fuel.

This study aims to:

- Develop scenarios based on the most likely implementation plan of the PUVMP;
- Compare energy demand of the different scenarios and that of the baseline estimates (under Modelling and Estimation of Transportation Energy Demand of the Philippines) focusing on road public transport

At the end of this study, the researchers are expected to obtain an estimation of public transport energy of scenarios based on PUV modernization. This would be useful in formulating new policies and recommendations on road/land public transportation.

2. REVIEW OF RELATED LITERATURE

2.1 Analysis and Update of the Philippine Transport Energy Demand (2003)

This study by Bayot, G.B. and Majarucon, C.O (2003) estimates the total energy demand of the different transportation modes in the country, namely: Land, Air, Water, and Pipeline transport systems. The country lacks studies on transport energy demand. The existing studies usually are about the total consumption of different transportation modes without analyzing the data. Analyzing and having knowledge in the energy demand provides an insight on how energy is consumed, especially in the transportation sector. The study also estimates the total energy demand by passenger and freight transport for each mode. Through this study, they identified which of the transportation modes are the largest consumer of energy, as well as the most efficient.

The total energy consumption of both passenger and freight transport from 1997 to 2001 were collected from secondary sources, which were used in the computation and analysis of data. The findings include the road/land transport sector having an increasing demand in energy, as well as being the highest consuming transport sector in 2001. Passenger transport also consumes higher energy than freight transport.

In conclusion, the road/land transport sector is the largest energy consumer in the country, while the rail transport sector is the least energy consuming sector. Both the road and rail sectors have an increasing demand in energy, while air and water transport sectors have variable demands in energy.

In totality, an increasing demand in energy is seen in the entire transportation sector. Based on efficiency, in which only the road and rail transport sector data were obtained, road transport is more efficient than rail transport.

2.2 Public Utility Vehicle Modernization Program (PUVMP)

Public Utility Vehicle Modernization Program (PUVMP) is a transformational initiative project of the Duterte Administration. It involves replacing PUVs that are at least 15 years old including an estimated number of 179,000 units of PUJs nationwide. PUVMP aims to develop a restructured, modern, well-managed, and environmentally sustainable transport sector where operators and drivers have improved livelihoods while commuters get to their destinations quickly, safely and comfortably.

2.3 Local Public Transport Route Plan (LPTRP)

The Local Public Transport Route Plan (LPTRP) is defined in the Local Public Transport Route Plan Manual as a plan detailing the route network, mode, and required number of units per mode for delivering public land transport services. It is developed by local government units and is approved by the LTFRB. It also serves as the basis of the comprehensive local transport plan.

Traditionally, it is the Department of Transportation's Road Transport Planning Division who determines the public transportation routes for franchising based on the requests of public utility vehicle (PUV) operators. Thus, due to the supply-driven process of route allocation, the approved routes are often not integrated or interconnected with one another.

To improve the efficiency of public transportation route plans in Philippine cities, the decentralization thrust of Republic Act No. 7160 or "The Local Government Code of the Philippines (LGC)" and the Comprehensive Land Use Plan (CLUP) mandated LGUs to provide access and mobility to people through public transportation services so that they can utilize and participate in the different socioeconomic activities and amenities of LGUs. In response to this law, the new Omnibus Franchising Guides were implemented by the LTFRB to empower LGUs to craft their own LPTRPs that reflect appropriate solutions to their public transportation service requirements. As compliance to these guidelines, DOTr requires LGUs to issue a certification that attests the need for public transport services based on LGU development plans prior to designating and enforcing public transport routes. Each city or municipality has its own unique transport network systems and social-economic factors in which respective LGUs are more familiar. This process recognizes the mastery of LGUs of their own mobility and accessibility needs as well as allows the integration of the local policies and ordinances suited for established transport plans to address local transportation problems. As such, it is in the best interest of LGUs to take charge of local route planning.

While it is the responsibility of LGUs to craft LTPRPs and the responsibility of DOTr to oversee this, the DILG is tasked to help both DOTr and LTFRB in requiring LGUs to comply with LTPRP preparation. On the other hand, the LTFRB is tasked as the economic regulator of the public transportation sector.

3. METHODOLOGY

One of the preliminary sources of information on the present state of public transportation in the selected cities would be the LPTRPs. All cities and municipalities in the country were required by the LTFRB PUVM-NPMO (PUV Modernization-National Project Management Office) to submit their own LPTRP, including the selected areas in this study. From the LPTRP, existing information on the current operating fleets of PUVs, including that of tricycles and their respective routes and terminals can be obtained. Cities and municipalities were also tasked to devise an improved public transportation system and a new route plan that may be used by a modernized fleet of PUVs. This new system and route will be used in the study as a probable PUVMP implementation plan. The energy demand of these proposed scenarios will be compared to the energy demand of the existing public transportation system.

As per the latest update on the team's request for access to the LPTRPs of the selected cities and municipalities, according to the person/s in charge in the PUVM-NPMO, collection of the LPTRP is only at 3-5% of 1,488 municipalities, 23 of which is already approved and the rest, subject to review by the PUVM-NPMO.

Due to the current situation in the country (COVID-19 Pandemic), the team was not able to conduct fieldwork to gather primary data; thus, only secondary data were used. Data were obtained from the LPTRP of different cities and municipalities and other research related to the study. In addition, only a limited number of LPTRPs were collected from different cities and municipalities around the Philippines. The team only have five (5) LPTRPs; 2 highly urbanized cities, 2 component cities and 1 municipality. LPTRPs obtained by the researchers are listed below:

1. Dinalupihan (Luzon)
2. General Santos City (Mindanao)
3. Mabalacat (Luzon)
4. Ormoc City (Visayas)
5. Zamboanga City (Mindanao)

Data from LPTRPs and other sources were analyzed using the method used in the study entitled *Analysis and Update of the Philippine Transport Energy Demand* conducted by Bayot, G.B. and Majarucon, C.O (2003). In the study, wherein energy demands of road, rail, air and water transportations from 1997 to 2001 were analyzed using a bottom-up approach, the following parameters were used to obtain energy demand of road transport:

- Annual average kms per vehicle
- Average load factor
- Fuel consumption rate

The *average distance traveled* by selected vehicles (ave kms per vehicle, km) was used to solve for total *vehicle-kilometers* (veh-kms, km) of the fleet,

Veh-kms *= no of vehicles * annual ave kms per vehicle* (1)

The average load factor was used to obtain the total *number of the passengers* serviced (equation 2), which, in turn, was used to solve for the total *passenger-kilometers* (passenger-km) of the fleet as seen in equation 3.

No of passengers *= ave load factor * veh-kms* (2)
Passenger-kms *= no of passengers * annual ave kms per vehicle* (3)

The following formula was used to arrive to the *total fuel consumed* (L/veh):

Fuel consumed *= fuel consumption rate * annual ave kms per vehicle* (4)

The obtained value of total fuel consumed in L was then converted to BFOE (Barrels of Fuel Oil Equivalent) using the respective conversion factors for gasoline and diesel, depending on the fuel used by the sample vehicle.

Fuel consumed, in BFOE *= fuel consumed, in L(gasoline)*(0.847*1000)/(0.158987)* (5)
Fuel consumed, in BFOE *= fuel consumed, in L(diesel)*(0.9328*1000)/(0.158987)* (6)

The fuel efficiency, measured in km/L, could be obtained using this formula

Efficiency *= passenger-kms / fuel consumed* (7)

From the results of the mentioned study, it was concluded that there is an increasing demand in energy from 1997 to 2001, with the highest consumption being in 2001. It was also concluded that among all modes of transportation analyzed (road, rail, air and marine), road transport has the largest energy demand and is more efficient as compared to rail transport.

In this research, the range of the total fuel efficiency at baseline conditions and at proposed conditions as given in the LPTRP were compared. To obtain the total fuel efficiencies at both conditions, the steps previously mentioned were generally followed, with the fuel efficiency (in km/L) being the final value computed. The following data were used:

- Number of units per route
- Average roundtrip distance travelled per route (in km)
- Frequency of trips (per day)
- Average load factor
- Fuel consumption rate (minimum and maximum, in L/Km)

For most LPTRPs analyzed in this study, the number of units for each PUV and their respective routes were given. In cases where it was not given, the number of units for each route was only estimated. This is further discussed in section 2.5 of this study. Furthermore, the annual average kilometers travelled per vehicle was obtained by multiplying the round trip lengths of existing routes found in the LPTRP by the frequency of trips made per day; this is then further multiplied by 365 days. In the case wherein the distance of routes were not given in the LPTRP, the researchers estimated route distance by using the measure distance function in Google Maps. For the average load factor, a value of 0.65 was used in cases wherein it was not given in the LPTRP. Also, frequency of trips per vehicle were available or could be easily estimated from the given data in the LPTRPs; data on these and how they were estimated were further discussed in section 2.5 of this study.

Lastly, the vehicle fuel consumption rate, which is also model specific, was sourced from studies wherein fuel consumption of vehicles were measured at a business as usual setting.

Since fuel consumption rate highly varies depending on the engine model, condition and age, passenger capacity and road and traffic conditions, among many others, the team opted to use both the minimum and maximum fuel consumption rate available in the mentioned studies for each type of vehicle. Table 1 provides a summary of fuel consumption rates used in in the computations.

Table 1. Fuel consumption rates

Vehicle	**Fuel**	**Minimum Fuel Consumption Rate (L/Km)**	**Maximum Fuel Consumption Rate (L/Km)**
Jeepney	Diesel	0.05	0.32
E-jeepney	Electricity	0.05	0.1
Multicab/Filcab/UV	Diesel	0.104	0.176
Minibus	Diesel	0.334	0.546
Tricycle (2-stroke)	Gas	0.041	0.11

4. RESULTS AND DISCUSSION

In this section, the energy demand at baseline and proposed conditions were compared and discussed using the methods stated in section 3.

4.1. Dinalupihan

In Dinalupihan, only 2 PUV typess were considered in computations -- jeepneys and tricycles. For the baseline condition of jeepneys in Dinalupihan, the jeepney routes, number of units, average distance travelled, average load factor and frequency of trips of each route were given in the LPTRP.

Table 2 shows a comparison of energy demand of both jeepneys and tricycles at baseline and at proposed conditions.

Table 2. Comparison of energy demand at baseline and proposed conditions in Dinalupihan

PUV	Baseline Conditions				Proposed Conditions			
	Fuel Consumed (BFOE in millions)		Fuel Efficiency (km/L in millions)		Fuel Consumed (BFOE in millions)		Fuel Efficiency (km/L in millions)	
	Min	Max	Min	Max	Min	Max	Min	Max
Jeepney	7731.30	49480.33	2362.71	15121.32	15979.62	102269.54	4891.01	31302.49
Tricycle	1119.63	3003.87	43986.57	118012.75	616.98	1655.30	22617.54	60681.22
TOTAL	**8,850.93**	**52,484.21**	**46,349.28**	**133,134.07**	**16,596.59**	**103,924.84**	**27,508.56**	**91,983.71**

From the results of the total energy demand of both jeepneys and tricycles, an 87.5% to 98% increase in fuel consumption and a 41% to 31% decrease in fuel efficiency was computed once the changes in the Dinalupihan transport system had been implemented.

Generally, there is very little to no change in jeepney routes and number of units of jeepneys for each route. However, a huge modal shift from tricycles to jeepneys is anticipated. This means that the number of trips made by jeepneys will increase drastically, resulting in around 106% increase in jeepney fuel consumption. Despite this, jeepneys will be more efficient by 107%.

On the other hand, tricycles will have a 45% decrease in fuel consumption at proposed conditions, but their fuel efficiencies will also decrease by 48.6%, meaning, tricycles will be able to travel a shorter distance with the same amount of fuel.

4.2. General Santos City

In General Santos City, 3 PUV types were considered -- jeepneys, filcabs and tricycles. For jeepneys at baseline conditions, all required data were given in the LPTRP, with the exception of frequency of trips and average load factor, which were only estimated.

Similar to PUJs, data of filcabs at baseline conditions in General Santos City were also available in the LPTRP, except for frequency of trips and average load factor.

Since there is no zoning system at baseline conditions in General Santos City, the whole city, itself, was considered to become the only tricycle zone at this condition. Values for average distance travelled and frequency of trips made by tricycles per day were estimated.

At proposed conditions, previously mentioned jeepney and filcab routes have been merged into 14 new jeepney routes. For these, all required data was given in the LPTRP. Tricycles at proposed conditions will be following a zoning system. Due to lack of data, required data were all estimated for tricycles at proposed conditions.

Table 3 shows a comparison of energy demands of all modes of public transportation in General Santos City at baseline conditions and at conditions where recommendations made in the LPTRP have been implemented.

Table 3. Comparison of energy demand at baseline and proposed conditions in General Santos City

PUV	Baseline Conditions				Proposed Conditions			
	Fuel Consumed (BFOE in millions)		Fuel Efficiency (km/L in millions)		Fuel Consumed (BFOE in millions)		Fuel Efficiency (km/L in millions)	
	Min	Max	Min	Max	Min	Max	Min	Max
Jeepney	28586.72	182955.03	15671.88	100300.01	42139.45	269692.50	31714.55	202973.11
Filcab	35774.27	60541.08	25079.29	42441.87	0.00	0.00	0.00	0.00
Tricycle	163912.74	439765.89	35474617.17	95175802.18	59235.26	158923.88	5348572.66	14349829.07
TOTAL	**228,273.74**	**683,262.00**	**35,515,368.34**	**95,318,544.06**	**101,374.72**	**428,616.38**	**5,380,287.20**	**14,552,802.18**

One major factor contributing to the decrease in total fuel consumption in General Santos city is the proposed zoning system of tricycles; once a zoning system is implemented, tricycles would be limited to travel only within their specific zones, which results in lesser distance travelled. Secondly, since filcabs will be removed entirely from the public transport system of the city, the fuel consumption of filcabs will decrease by 100% at proposed conditions. However, it is also for this reason why there will be a slight increase in fuel consumption by jeepneys; since a number of PUJ and filcab routes at baseline conditions have been merged to become an entirely new PUJ route and the fact that there will be less options for public modes of transport, there will be around 47% increase in total jeepney fuel consumption, but will be a lot more efficient.

In totality, there will be a decrease both in fuel consumption and efficiency of all modes of public transportation at proposed conditions; decrease of fuel consumption is at a range of 37.27% to 56.23% and will be 85% less efficient in General Santos City.

4.3 Mabalacat

Only the fleet size per route, average travel time and hours of operation were given in Mabalacat's LPTRP. The frequency of trips was computed by dividing the total hours of operation by the average travel time, with the assumption that all the units are operating. Since there was no average load factor given in the LPTRP, 0.65 was used.

The only information given about the baseline conditions of transport by tricyle were that the total number of units is 5,000 to 6,000 and the average peak hour volume count per road segment survey results. There was no zoning mentioned for the baseline conditions and it was also mentioned that tricycles were mostly used for inter-zonal transport within the city. It was assumed that the whole city is the zone and that the total frequency of trips per day is the total peak hour volume count multiplied by the assumed operating hour which is 24 hours. The average vehicle-kilometer distance was taken by taking the centroid of the total of the tricycle serviced areas -- the tricycle zone. The distance from the centroid to the farthest distance from the edge of the tricycle zone.

Some routes, including the new routes do not have any data on the travel time or the number of operating hours, therefore the frequency of trips is unknown and must be assumed for computation.

The total estimate of the energy demand of PUJs and tricycles are shown in Table 4, together with their comparison with the proposed routes.

Table 4. Comparison of energy demand at baseline and proposed conditions in Mabalacat City

PUV	Baseline Conditions				Proposed Conditions			
	Fuel Consumed (BFOE in millions)		Fuel Consumption Rate (km/L in millions)		Fuel Consumed (BFOE in millions)		Fuel Consumption Rate (km/L in millions)	
	Min	Max	Min	Max	Min	Max	Min	Max
PUJ	752.60	4816.62	2141.20	334.56	1034.51	6620.87	2394.21	374.10
Tricycle	43664.61	117148.96	19015367.15	7087545.94	11127.40	29853.99	481939.76	179632.09
TOTAL	**44417.21**	**121965.58**	**19017508.35**	**7087880.50**	**12004.29**	**35466.10**	**484047.85**	**179961.48**

There is a significant decrease in the total fuel consumption, largely due to the tricycle zoning system. There is still evident increase in fuel consumption in the PUJs due to the addition of four new routes. The 16.52% increase in fuel consumption of the PUJs is eclipsed by the 74.54% decrease in fuel consumption of the tricycles, which yields a total range of 71.24% to 73.11% decrease in fuel consumption.

The overall fuel efficiency of the PUVs decreased by a range of 97.45% to 97.46%. The increase in fuel consumption in PUJs caused 1.55% decrease in fuel efficiency, however, even though fuel consumption significantly decreased in tricycles, the fuel efficiency decreased by 97.47%.

4.4 Ormoc City

For the baseline conditions, the number of registered units and frequency of trips were taken from the LPTRP authored by the LGU. The fuel consumed in BFOE was computed using the same methodology from the previous cities. Since no data for load factor was given, the researchers assumed a load factor of 0.65 for all types of PUVs. Also, the exact route length was not given in the LTPRP, but a map of the routes were given and measured manually in Google Maps by the researchers.

On the other hand, only zone maps and the number of units per zone were given by the LPTRP. Other important data such as frequency of trips and distance travelled were estimated.

For the proposed conditions, the LPTRP of Ormoc states that the Ormoc City Planning office plans to introduce e-jeepneys as new public conveyance to service both old and new routes within the city. The computations were made considering the 10-year projection for the number of PUVs servicing the routes, with a certain number of units added per route every two years. Likewise, data such as frequency of trips, distance of routes, and average load factor were estimated similarly to the baseline conditions.

It is proposed that these new e-jeepneys will replace old jeepneys, multicabs and tricycles within the city.

Table 5 shows a comparison of energy demand of both jeepneys and tricycles at baseline and at proposed conditions.

Table 5. Comparison of energy demand at baseline and proposed conditions in Ormoc

PUV	Baseline Conditions				Proposed Conditions			
	Fuel Consumed (BFOE in millions)		Fuel Efficiency (km/L in millions)		Fuel Consumed (BFOE in millions)		Fuel Efficiency (km/L in millions)	
	Min	Max	Min	Max	Min	Max	Min	Max
Jeepney/ Multicab/ e-Jeep	11,051.13	19,746.67	2,692.56	4,577.07	256,057.95	178,978.97	256,057.95	499,294.41
Tricycle	9,116.17	24,458.02	150,486.14	403,743.32	0.00	0.00	0.00	0.00
TOTAL	**20,167.3**	**44,204.69**	**153,178.7**	**408,320.39**	**256,057.95**	**178,978.97**	**256,057.95**	**499,294.41**

From the results of the total energy demand of all PUVs, a 304.89% to 355.13% increase in fuel consumption and a 22.28% to 67.16% increase in fuel efficiency was computed once the changes in the Ormoc transport system had been implemented after 10 years.

The proposed route plan is expected to bring a huge jump in fuel consumption brought about by a greater number of trips and significantly more routes. However, it is also expected that the new route plan will be slightly more energy efficient due to the greater fuel efficiency of e-jeeps as compared to regular jeepneys, multicabs, and tricycles.

4.5 Zamboanga City

In Zamboanga City, the routes of mini buses, UV Express, and jeepneys in the major corridors of the CBD are considered in the computation of fuel efficiency. The parameters needed in the computation such as the number of units per mode, route lengths, and frequencies of trips are provided in the LPTRP. The average load factor was assumed to be 0.7 for all modes of transport.

For the recommended conditions given in the LPTRP, the total fuel consumption is computed using the given route lengths and proposed number of vehicles per route.

Presented in Table 6 is the summary of the results of the total energy demand of all PUVs. The table shows a 27.36-27.52% increase in fuel efficiency in km/L for mini buses, 26.96% increase in fuel efficiency in km/L for UV Express, and 28.99% increase in fuel efficiency in km/L for jeepneys. An increase of 0.14% to 0.37% in fuel efficiency in km/L for all PUVs was computed due to the 2.38% annual increase in fleet size per route.

Table 6. Comparison of energy demand at baseline and proposed conditions in Zamboanga City

Comparison of Fuel Consumed (BFOE in millions) of PUVs in Zambonaga City					
Mini Bus		Baseline	Proposed	% Difference	increase/decrease
	min	701.18	701.18	0	same

	max	126.35	126.35	0	same
UV Express		Baseline	Proposed	% Difference	increase/decrease
	min	107.35	107.35	0	same
	max	181.67	181.67	0	same
Jeepney		Baseline	Proposed	% Difference	increase/decrease
	min	182.73	182.73	0	same
	max	1169.48	1169.48	0	same
Tricycles		Baseline	Proposed	% Difference	increase/decrease
	min	37,427.01	37,427.01	0	same
	max	100,413.94	100,413.94	0	same
TOTAL (mini bus + uv express + jeepney + tricycle)		Baseline	Proposed	% Difference	increase/decrease
	min	38,418.28	38,418.28	0	same
	max	101,891.43	101,891.43	0	same
Comparison of Fuel Efficiency (km/L in millions) of PUVs in Zamboanga City					
Mini Bus		Baseline	Proposed	% Difference	increase/decrease
	min	59.86884176	82.41820633	27.35968856	increase
	max	308.06146	425.0469895	27.52296391	increase
UV Express		Baseline	Proposed	% Difference	increase/decrease
	min	60.84339423	83.29791346	26.95688079	increase
	max	35.95291477	49.22149432	26.95688079	increase
Jeepney		Baseline	Proposed	% Difference	increase/decrease
	min	237.2075286	334.026903	28.98550193	increase
	max	37.06367634	52.19170359	28.98550193	increase
Tricycles		Baseline	Proposed	% Difference	more/less efficient?
	min	37,427.01	37,427.01	1.94404E-14	same
	max	100,413.94	100,413.94	0	same
TOTAL (mini bus + uv express + jeepney + tricycle)		Baseline	Proposed	% Difference	more/less efficient?
	min	37,784.93	37,926.76	0.373939867	more efficient
	max	100,795.01	100,940.40	0.144027706	more efficient

5. CONCLUSION AND RECOMMENDATIONS

The research project has been seriously affected by the COVID-19 pandemic and was not implemented as planned. The project initially targeted 18 cities and municipalties spread all over the country, requiring actual visit and data collection through the conduct of transport and traffic surveys as well as obtaining secondary data from concerned agencies. The project further assumed that substantial number of LGUs' LPTRP would have been submitted to LTFRB for approval and that these LPTRPs could be used to supplement the data gathered from the field. Somehow, the researchers were able to obtain 5 LPTRPs from various sources but not from LTFRB. These 5 LPTRPs serve as case studies for the project and therefore do not necessarily represent the transport and traffic conditions in the country. Nevertheless, there is clear indication that energy consumption for the public transportation sector would depend largely on the policies and plans of the different LGUs. Due to limited information on the plans of LGUs with respect to PUV modernization program of the government, it is not clear whether many LGUs will follow the use of electric vehicles for their public transportation. Ormoc City for instance is following this path and based on its plan, despite the expected increase in the number of public transport vehicles, there is significant reduction in fuel consumption and increase in fuel efficiency due to the shift to electric vehicles. Table 7 summarizes the potential impact on energy consumption based on LGUs proposed plans.

Table 7. Summary of potential impact on energy consumption

LGU	Category	Proposed Changes in Public Transport	Potential impact
Dinalupihan	Municipality	No changes in PT mix; the LGU adopts existing number of PUJs and tricycles but will ban tricycles from using the national road by building local road parallel to the highway	A modal shift from tricycles to jeepneys; increase in total fuel consumption by 88 to 98%; decrease in fuel effieciency by 31 to 41%.
General Santos	City	Lessen the total number of PUJ/Filcab routes; 4-zone system for tricycles	total fuel consumption will decrease by 37% to 56% and total fuel efficiency is expected to lessen by around 85%.
Mabalacat	City	Tricycle zoning system; additional 4 new jeepney routes	The 16.52% increase in fuel consumption of the PUJs is eclipsed by the 74.54% decrease in fuel consumption of the tricycles, which yields a total range of 71.24% to 73.11% decrease in fuel consumption.
Ormoc	City	Transition to electric transportation system within 10 years. Significant increase in a number of routes (from 6 intracity routes to 31) and PUVs within the city to service the resettlement areas and other underserved baragays in the city.	an expected 305-355% increase in fuel consumption for intra city trips. However, it is expected that these trips would be 22-67% more efficient mainly due to the fact that e-jeepneys are generally more efficient than their jeepney,

			multibus, and tricycle counterparts
Zamboanga	City	Introduction of high occupancy vehicles such as buses and mini buses for the two major corridors in the Central Business District. Tricycles cannot operate along national roads.	2.38% increase in fleet size annually per route; 27.36 - 27.52% increase in fuel efficiency in km/L for mini buses, 26.96% increase in fuel efficiency in km/L for UV Express, 28.99% increase in fuel efficiency in km/L for jeepneys, and 0.14% to 0.37% increase in fuel efficiency in km/L for all PUVs

RECOMMENDATIONS

1. PUV Data for planning, operation and management

In the course of the Study, it was found out that almost all LGUs have no available basic information related to PUV planning, operation and management. The following are recommended to resolve this issue:

a. Develop a public transport database and updating system which should include among others: operation information such as route, loading and unloading points, service information, etc., and demand information (person trip details, Origin Destination table).
b. Support the integration of the person trip survey into the housing census: In order for an LGU to conduct the person trip survey without enormous expense, the possible integration of the person trip survey into housing census conducted every five years by the Philippine Statistics Authority (PSA) should be considered.

2. Strengthening LGU Capacity on PUV Planning

In relation to the public transportation, the Local Government Code stipulates that LGUs shall provide adequate, effective, and efficient transportation facilities that would provide access and mobility for its people to pursue socio-economic activities. Moreover, the Joint Memorandum Circular No. 001 Series of 2007 between the Department of Interior and Local Government (DILG) and the Department of Transportation (DOTr) provides that each LGU shall formulate the local public transport plan (LPTRP) for the intra-city routes of public road transport. LPTRP is also supposed to be revised every three years from its formulation. LGUs are expected to rationalize existing routes based on passenger demand, road hierarchy, and road capacity and develop their own LPTRPs to identify new or developed routes. However, most LGUs may not have the capacity to create the LPTRP by themselves. Many LGUs have limited human resources, and developing human resources to continuously formulate and review route plans has become an issue. Many LGUs have no specialized office for transport planning. It is not uncommon that many LGUs would simply outsource the work to private firms instead of doing the Plan themselves. Strengthening the capacity of LGUs on route planning and management must be given high importance.

3. Use of Electric Public Utility Vehicles

Due to COVID – 19 pandemic only five (5) LGU LPTRPs were obtained which served as case studies for the project and therefore do not necessarily represent the transport and traffic conditions in the country. Nevertheless, there is clear indication that energy consumption for the public transportation sector would depend largely on the policies and plans of the different LGUs. Due to limited information on the plans of LGUs with respect to PUV modernization program of the government, it is not clear whether many LGUs will follow the use of electric vehicles for their public transportation. However, the case of Ormoc City would show that, despite the expected increase in the number of public transport vehicles, there is significant reduction in fuel consumption and increase in fuel efficiency due to the shift to electric vehicles.

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