# A Consolidated Economic Analysis of Alternative Fuel for Public Utility Jeepneys

Mercado Jose Gabriel, and Quiros Edwin N.

Abstract— This paper presents the economic analysis of a two-phase Philippine study of different alternative fuel vehicles used for Public Utility Jeepneys (PUJ's) that are plying two separate Metro Manila urban routes. Two economic models were generated using data for the two routes and in both models, in terms of fuel economy (fuel cost in Pesos per Passenger-Km) versus the Diesel Jeepney, the Electric Jeepney is 35%-46% more economical, while the LPG Jeepney is 2%-51% less economical. In terms of Net Income per Passenger-Km, trend is the same, as the Electric Jeepney has 10-31% higher net income, whereas the LPG Jeepney has 0.19-8% lower net income.

Index Terms— alternative fuel, diesel, economic analysis, electric, LPG

## I. INTRODUCTION

THE PHILIPPINES' PUBLIC UTILITY JEEPNEY (PUJ) IS ONE ■ OF THE CHEAPEST AND THE MOST POPULAR MODE OF TRANSPORTATION IN THE COUNTRY. CONSIDERED AS THE SYMBOL OF FILIPINO'S CREATIVITY AND INGENUITY, PUJ'S ARE DERIVED FROM US MILITARY JEEPS AND ARE USUALLY ASSEMBLED USING SHOP FABRICATED BODIES AND CHASSIS. THEN FITTED WITH SECOND HAND ENGINES. PUJ'S ACCOUNT 74 MILLION PASSENGER-KILOMETERS TRAVELLED IN METRO MANILA ANNUALLY [1] DESPITE ITS ORIGINAL PURPOSE TO SERVE FEEDER ROUTES TO THE BIGGER TRANSPORT MODES (BUSES AND LIGHT RAIL WAYS). MOREOVER, MOST ARE STILL USING OLD AND DILAPIDATED DIESEL ENGINES THAT ACCOUNT FOR 15% OF THE PARTICULATE MATTER EMISSIONS IN METRO MANILA [2],[3]. WITH THE ADVANCEMENT OF ALTERNATIVE VEHICLE TECHNOLOGIES, CALL FOR A CLEANER ENVIRONMENT, AND THE PUSH FOR A "JEEPNEY MODERNIZATION PROGRAM"[4], DIFFERENT ALTERNATIVE FUEL VEHICLE OPTIONS ELECTRIC, DIESEL-ELECTRIC HYBRID, LPG, COMPLIANT DIESEL ENGINES, ARE BEING PROPOSED TO REPLACE THE CURRENT FOSSIL FUELED JEEPNEYS.

RELEVANT DATA INCLUDING REVENUE COSTS, EXPENSES, AND INCOMES WERE GATHERED AND USED IN THE COMPARISON OF THE OPTIONS. TWO ECONOMIC MODELS WERE MADE. EACH HAD A SET OF ASSUMPTIONS TO

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SIMULATE BOTH REALISTIC AND IDEAL SCENARIOS.

THIS STUDY IS A PART OF THE FUEL EFFICIENCY IN ROAD TRANSPORT PROGRAM OF THE PHILIPPINE DEPARTMENT OF ENERGY (DOE) AS TECHNICAL SUPPORT.

THE SPECIFIC OBJECTIVES OF THIS PAPER ARE AS FOLLOWS:

- a) To provide economic analysis for the onroad tests of the following: Electric Jeepney, LPG Jeepney, and Diesel Jeepney.
- b) To identify operational issues, if any, and provide recommendations

# II. METHODOLOGY

This study was divided into two phases, with Phase 1 having a less severe stop-and-go driving condition than Phase 1 because of more on-road stretches of relatively constant speed sections.

PUJ's from a transport cooperative using routes that fit Phase 1 and Phase 2 conditions were used. These PUJ's have passed inspection for roadworthiness and exhaust smoke opacity compliance conducted at the North Motor Vehicle Inspection Center of the Philippine Land Transportation Office.

The on-road test was designed to run for 72 days. The schedule of the transit operation was from 6:00 AM to 7:30 PM, Monday to Saturday, and all drivers of the test vehicles followed normal work breaks (meals, snacks) of drivers of other PUJ's operating in the route. Daily operational characteristics such as daily vehicle operation information (operation cost and revenue) and passenger station origindestination were collected by a surveyor. Designated stops for the route were strictly followed by the drivers .The total length of the route for the first phase was 13.25 km roundtrip with 6.75 km from SM North Edsa to UP Diliman and 6.25 km from UP Diliman to SM North Edsa. For Phase 2, the selected route was SM North Edsa to Litex via Commonwealth Avenue, with route length of 20.8 km round-trip, with roughly similar westbound and eastbound route lengths of 10.4 km each.

The full tank method of refueling was used in the measurement of the daily fuel consumption for the Diesel and LPG Jeepneys. Likewise, kWh used to charge Electric Jeepneys were measured as their fuel consumption.

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## III. DATA ANALYSIS AND DISCUSSIONS

# Model A.

The first model (Model A) utilizes actual data gathered from the on-road tests conducted. This model reflects actual conditions and shows all the revenues and expenses of the operator during the testing period. Data on actual number of passengers and distance travelled were also used to calculate performance parameters.

The Test Period indicates the total number of testing days. In some of these days, the test vehicle was down due to repairs needed. These are shown in "Downtime Days". Testing days that fell on a Sunday or a holiday were considered as "No Operation Days". Thus, both these days were deducted from the Test Period get the "Days Considered".

The Gross Income was computed from the total fare collected by the drivers during operation. Costs included in the Total Operating Expenses were fuel costs/charging costs, terminal fee, dispatcher's fee, and repairs and maintenance. Net Income over the entire testing period is calculated by

Net Income =Gross Income from Fares- Total Operating Expenses

This also assumed that the driver is the operator of the PUJ thus there is no "boundary" (payment made by the driver to the operator of the jeepney) as part of the expenses incurred.

Average daily parameters were also calculated. The Gross Income, Operating Expenses, and the Net Income were all divided by the sum of Considered Days plus Downtime Days to get the average Daily Gross Income, Daily Operating Expenses, and Daily Net Income. The data are shown in Table I-II

Daily Gross Income = Gross Income

**Total Gross Income** Daily Gross Income= Considered Days + Downtime Days

**Total Operating Expenses** Daily Operating Expense= $\frac{\text{Considered Days} + \text{Downtime Days}}{\text{Considered Days} + \text{Downtime Days}}$ 

Net Income  $Daily \ Net \ Income = \frac{}{Considered \ Days + Downtime \ Days}$ 

> Table I Data for Phase 1 (Model A)

	` ′			
Diesel	LPG	Electric		
UVH 491	ZTS 904	ZZI 169		
20	20	16		
20	20	10		
Operational Data				
72	108	72		
12	108	12		
52	37	41		
	UVH 491 20 Operationa 72	UVH 491         ZTS 904           20         20           Operational Data           72         108		

Days				
No Operation	16	41	20	
Days	10	41	29	
Downtime Days	4	30	2	
Total	24,110	15,616	11,061	
Passengers	24,110	13,010	11,001	
Load Factor	0.6347	0.5981	0.6374	
Total Distance	8,713	6,063.31	4,807.17	
Travelled (km)	0,713	0,005.51	4,007.17	
Total Fuel	1,294.16	1,282.68	1,421.4	
Consumed (L) <sup>1</sup>	1,2,74.10	1,202.00	1,721.7	
Gross Income	211,646.7	131,047.97	94,331.0	
(Php)		,	74,331.0	
	EXPENSE	S (Php)		
Fuel/Energy	52,196.47	37,624.49	15,635.40	
Cost		·	•	
Terminal Fee	15,260.00	7,405.00	7,910.00	
Dispatcher's Fee	4,450.00	5,854.00	5,720.00	
Maint./Repair	6,325.00	7,633.00	3,507.00	
Expenses	0,323.00	7,033.00	3,307.00	
Total Operating	78,231.47	58,516.49	32,772.40	
Expenses	,	,		
NET INCOME	133,415.22	72,531.48	61,558.60	
AVERAGE PERFOMANCE INDICATORS (Php)				
Daily Gross	3,779.41	1,955.94	2,193.74	
Income	3,777.11	1,555.51	2,173.71	
Daily Operating	1,396.99	873.38	762.15	
Expenses	1,570.77	073.30	, 02.13	
Daily Net	2,382.41	1,082.56	1,431.60	
Income	2,302.71	1,002.30	1,451.00	

Table II Data for Phase 2 (Model A)

	Data for Phase 2 (Model A)			
Type	Diesel	LPG	Electric	
Plate Number	UWK 720	UUB 169	AAZ4219	
Passenger	24	24	20	
Capacity			20	
	Operation	al Data		
Test Period,	31	50	60	
Days	31	30	00	
Considered	21	44	41	
Days	21	44	41	
No Operation	5	6	8	
Days	3	0	0	
Downtime	5	0	11	
Days	3	U	11	
Total	4,991	10,819	11,061	
Passengers	4,771	10,619	11,001	
Load Factor	0.6959	0.6974	0.6826	
Total Distance				
Travelled	3,072	8,068	4,901	
(km)				
Total Fuel				
Consumed	435.09	1,738.93	985	
$(L)^1$				
Gross Income	61 272 9	124 204 0	05 692 5	
(Php)	61,273.8	134,394.0	95,683.5	
EXPENSES (Php)				
Fuel/Energy	12,466.27	41,459.20	10,500.1	

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Cost			
Terminal Fee	1,120	1,645	2,034
Dispatcher's	4,260	10,663	4,710
Fee	.,200	10,000	.,,,,
Maint./Repair	6,825	7,633	3,507
Expenses	0,023	7,033	3,507
Total			
Operating	24,671.27	61,100.2	20,751.1
Expenses			
NET	36,602.53	73,293.8	74,932.4
INCOME	30,002.33	13,293.6	74,932.4
AVERAGE	E PERFOMAN	CE INDICAT	ORS (Php)
Daily Gross	2,356.68	3,054.40	1,840.06
Income	2,330.08	3,034.40	1,040.00
Daily			
Operating	948.895	1,388.64	399.06
Expenses			
Daily Net	36 602 52	73 202 9	74 032 4
Income	36,602.53	73,293.8	74,932.4

For a better and normalized comparison, the Fuel Cost and Net Income were viewed on a passenger-kilometer basis. This simply means that the parameters would be viewed by how much they cost to transport one passenger by one kilometer, as shown by the following formulas:

Fuel Cost (Php) per Passenger-Km=

Total Number of Passengers x Total Route Length (km) x Load Factor

Fuel Cost Php per passenger–km= Fuel Cost (Php)Number of Passengers x Total Length of Route km  $\,$ 

Net Income (Php) per Passenger-Km=

Total Number of Passengers x Total Route Length (km) x Load Factor

The Load Factor reflected the average percentage of passengers riding the PUJ per trip and was obtained from the passenger data. The resulting computation for Fuel Cost per passenger-km and Net Income per passenger-km is shown in Table III-IV:

**Table III**Normalized Data for Phase 1 (Model A)

	Diesel	LPG	Electric
Fuel Cost (Php)	52,196.47	37,624.49	15,635.40
Net Income (Php)	133,415.22	72,531.48	61,558.60
Total No. of Passengers	24,110	15,616	11,061
Load Factor	0.6347	0.5981	0.6374
Total Length of Route (km)	13.25	13.25	13.25
Fuel Cost, Php per passenger- km	0.25743023	0.3040262	0.1673734
Net Income, Php per passenger- km	0.65799681	0.5860937	0.6589711

**Table IV**Normalized Data for Phase 2 (Model A)

	Diesel	LPG	Electric
Fuel Cost (Php)	12,466.27	41,459.20	10,500.1
Net Income (Php)	36,602.53	73,293.8	74,932.4
Total No. of Passengers	4,991	10,819	11,061
Load Factor	0.6959	0.6974	0.6826
Total Length of Route (km)	20.8	20.8	20.8
Fuel Cost, Php per passenger- km	0.17255947	0.2622614	0.0933767
Net Income, Php per passenger- km	0.5066562	0.4670193	0.6663908

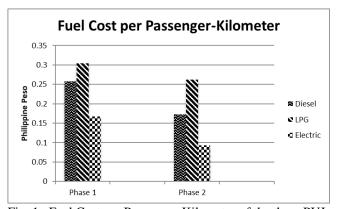


Fig. 1. Fuel Cost per Passenger-Kilometer of the three PUJ types in Phase 1 and Phase 2 using Model A.

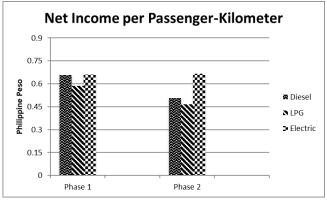


Fig. 2. Net Income per Passenger-Kilometer of the three PUJ types in Phase 1 and Phase 2 using Model A.

# Model B.

The second model (Model B) was an equalized model, where only the daily fuel cost and maintenance were variable and all other parameters were kept constant. It was assumed that all PUJ's have fixed daily expenses and have covered the same number of trips. The simulated testing

ISBN: 978-988-14048-9-3 ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online) period was 72 days. Phase 1 had 20 trips per day, with a fare of 11 pesos per passenger per trip, while Phase 2 had 14 trips per day, with a fare of 15 pesos per passenger per trip. Maintenance expenses were simulated using actual market prices and assumed recommended preventive maintenance frequency was followed. Load Factors from Model A were used in this model.

**Table V**Data for Phase 1 (Model B)

Type	Diesel Diesel	LPG	Electric
Plate Number	UVH 491	ZTS 904	ZZI 169
Passenger			
Capacity	20	20	16
	Assumed Ope	rational Data	<u> </u>
Test Period,	_		
Days	72	72	72
Considered	70	70	70
Days	72	72	72
No Operation	0	0	0
Days	U	U	U
Downtime	0	0	0
Days	U	O	U
Total	18,279	17,225	14,686
Passengers	10,279	17,223	14,000
Total Trips	20	20	20
per Day			
Load Factor	0.6347	0.5981	0.6374
Total			
Distance	9,540	9,540	9,540
Travelled	,,,,,,	7,8 .0	,,,,,,
(km)			
Liters/km,			
kWh/km	0.1485320	0.2115478	0.295683
(Electric)			
Price Php per	40	20	4.4
liter, Price	43	29	11
Php per kWh			
Total Fuel	60,930.829	58,526.819	31,029.01
Cost (Php)			
Gross Income	211,646.69	131,047.97	94,331.00
(Php)	EXPENS	ES (Php)	
Fuel/Energy	EAFENS	LS (Flip)	
Cost	60,930.829	58,526.819	31,,029.01
Terminal Fee	26,640	26,640	26,640
Dispatcher's	20,040	20,040	20,040
Fee	1,800	1,800	1800
Maint./Repair			
Expenses	11,750	9,250	6,000
Total			
Operating	101,120.83	96,216.82	65,469.01
Expenses	,0.00		,
NET	00.072.12	02.251.25	06.072.67
INCOME	99,952.13	93,261.26	96,073.65
AVERAGE PERFOMANCE INDICATORS (Php)			
Daily Gross			•
Income	2,792.68	2,631.64	2,243.65
Daily	1 404 46	1 226 24	000.20
Operating	1,404.46	1,336.34	909.29

Expenses			
Daily Net	1,388.22	1,295.30	1,334.36
Income	1,300.22	1,293.30	1,334.30

**Table VI**Data for Phase 2 (Model B)

Type         Diesel         LPG         Electric           Passenger Capacity         24         24         20           Assumed Operational Data           Test Period, Days         72         72         72           Considered Days         0         0         0           No Operation Days         0         0         0           Downtime Days         0         0         0           Total Possengers         18,279         17,225         14,686           Total Trips per Day         14         14         14           Load Factor         0.6959         0.6504         0.6826           Total Distance         10,483.2         10,483.2         10,483.2           Travelled (km)         0.141630         0.2155342         0.200979           Electric         28.65         23.67         10.66           Price Php per liter, Pr		Data for Phase 2 (Model B)			
Passenger Capacity	Type	Diesel	LPG	Electric	
Capacity	Plate Number	UWK 720	UUB 169	AAZ4219	
Test Period, Days	Passenger	24	24	20	
Test Period, Days         72         72         72           Considered Days         72         72         72           No Operation Days         0         0         0           Downtime Days         0         0         0           Total Passengers         18,279         17,225         14,686           Total Trips per Day         14         14         14           Load Factor         0.6959         0.6504         0.6826           Total Distance         10,483.2         10,483.2         10,483.2           Travelled (km)         10,483.2         10,483.2         10,483.2           Price Php per liter, Price Php per l					
Days   72   72   72   72   72   72   72   7		Assumed Ope	erational Dat	a	
Days         72         72         72           Days         0         0         0           No Operation Days         0         0         0           Downtime Days         18,279         17,225         14,686           Total Passengers         18,279         17,225         14,686           Total Trips per Day         14         14         14           Load Factor         0.6959         0.6504         0.6826           Total Distance         10,483.2         10,483.2         10,483.2           Travelled (km)         0.141630         0.2155342         0.200979           Electric)         Price Php per liter, Price         28.65         23.67         10.66           Php per kWh	·	72.	72	72	
Days   No Operation   Days   Downtime   Downtime   Downtime   Downtime   Downtime   Downtime   Days   Downtime   Downtime   Days   D		, -		, -	
Days         0         0         0           Downtime Days         0         0         0           Total Passengers         18,279         17,225         14,686           Total Trips per Day         14         14         14           Load Factor         0.6959         0.6504         0.6826           Total Distance Travelled (km)         10,483.2         10,483.2         10,483.2           Liters/km, kWh/km (Electric)         0.141630         0.2155342         0.200979           Price Php per liter, Price Php per kWh         28.65         23.67         10.66           Php per kWh         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           EXPENSES (Php)         EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating         74,451.146         74,564.432         48,619.630           Expenses         178,088.85		72	72	72	
Days         0         0         0           Downtime Days         18,279         17,225         14,686           Total Passengers         18,279         17,225         14,686           Total Trips per Day         14         14         14           Load Factor         0.6959         0.6504         0.6826           Total Distance Travelled (km)         10,483.2         10,483.2         10,483.2           Liters/km, kWh/km (Electric)         0.141630         0.2155342         0.200979           Price Php per liter, Price Php per liter, Price Php per kWh         28.65         23.67         10.66           Price Php per liter, Price Php per liter, Price Php per liter, Price Php per kWh         252,540         236,025         206,430           Gross Income (Php)         42,541.14         53,840.43         22,459.63           Gross Income (Php)         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Expenses         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDIC		-	-		
Downtime	-	0	0	0	
Days         0         0         0           Total Passengers         18,279         17,225         14,686           Total Trips per Day         14         14         14           Load Factor         0.6959         0.6504         0.6826           Total Distance Travelled (km)         10,483.2         10,483.2         10,483.2           Liters/km, kWh/km (Electric)         0.141630         0.2155342         0.200979           Price Php per liter, Price Php per liter, Price Php per kWh         28.65         23.67         10.66           Poss Income (Php)         42,541.14         53,840.43         22,459.63           Gross Income (Php)         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating         74,451.146         74,564.432         48,619.630           Expenses         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08 <td< td=""><td>•</td><td></td><td></td><td></td></td<>	•				
Total Passengers         18,279         17,225         14,686           Total Trips per Day         14         14         14           Load Factor         0.6959         0.6504         0.6826           Total Distance Travelled (km)         10,483.2         10,483.2         10,483.2           Liters/km, kWh/km (Electric)         0.141630         0.2155342         0.200979           Price Php per liter, Price Php per liter, Price Php per kWh         28.65         23.67         10.66           Php per kWh         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5		0	0	0	
Total Trips   per Day					
Total Trips per Day         14         14         14         14           Load Factor         0.6959         0.6504         0.6826           Total Distance Travelled (km)         10,483.2         10,483.2         10,483.2           Liters/km, kWh/km (Electric)         0.141630         0.2155342         0.200979           Price Php per liter, Price Php per liter, Price Php per kWh         28.65         23.67         10.66           Php per kWh         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Net         2,473,4563         2,242,494         2,191,		18,279	17,225	14,686	
Description					
Load Factor         0.6959         0.6504         0.6826           Total Distance Travelled (km)         10,483.2         10,483.2         10,483.2           Liters/km, kWh/km (Electric)         0.141630         0.2155342         0.200979           Price Php per liter, Price Php per kWh         28.65         23.67         10.66           Php per kWh         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           EXPENSES (Php)         EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Daily Net		14	14	14	
Total Distance Travelled (km)         10,483.2         20,0979         20,000         20,000         20,000         20,000         20,000         20,000         20,000         20,000         20,459.63         20,600         20,459.63		0 6959	0 6504	0.6826	
Distance Travelled (km)         10,483.2         10,483.2         10,483.2         10,483.2           Liters/km, kWh/km (Electric)         0.141630         0.2155342         0.200979           Price Php per liter, Price Php per kWh         28.65         23.67         10.66           Php per kWh         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           EXPENSES (Php)         EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating         74,451.146         74,564.432         48,619.630           Expenses         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         2,473,4563         2,242.494         2,191.810		0.0757	0.0504	3.0020	
Travelled (km)  Liters/km, kWh/km (Electric)  Price Php per liter, Price Php per kWh  Total Fuel Cost (Php)  Gross Income (Php)  Fuel/Energy Cost Terminal Fee Dispatcher's Fee  Maint./Repair Expenses  Total Operating Expenses  NET INCOME Daily Gross Income Daily Gross Income Daily Gross Income Daily Operating Daily Net Dispatch  AVERAGE PERFOMANCE INDICATORS (Php)  Liters/km, kWh/km 0.141630 0.2155342 0.200979 0.200979 0.2155342 0.200979 0.20097 0.2009		40	40.1		
(km)         Liters/km, kWh/km         0.141630         0.2155342         0.200979           (Electric)         Price Php per liter, Price         28.65         23.67         10.66           Php per kWh         Total Fuel Cost (Php)         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Daily Net         2,473,4563         2,242,494         2,191.810		10,483.2	10,483.2	10,483.2	
Liters/km, kWh/km         0.141630         0.2155342         0.200979           (Electric)         Price Php per liter, Price         28.65         23.67         10.66           Php per kWh         Total Fuel Cost (Php)         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           EXPENSES (Php)         EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191.810					
CElectric   Price Php per   liter, Price   28.65   23.67   10.66     Php per kWh					
Price Php per liter, Price         28.65         23.67         10.66           Php per kWh         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473.4563         2,242.494         2,191.810	· ·	0.141630	0.2155342	0.200979	
liter, Price         28.65         23.67         10.66           Php per kWh         Total Fuel         42,541.14         53,840.43         22,459.63           Cost (Php)         252,540         236,025         206,430           EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191,810	(Electric)				
Php per kWh         Total Fuel Cost (Php)         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473.4563         2,242.494         2,191.810	Price Php per				
Total Fuel Cost (Php)         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473.4563         2,242.494         2,191.810	liter, Price	28.65	23.67	10.66	
Cost (Php)         42,541.14         53,840.43         22,459.63           Gross Income (Php)         252,540         236,025         206,430           EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191,810					
Cost (Php)         252,540         236,025         206,430           EXPENSES (Php)           Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191,810		42 541 14	53 840 43	22 459 63	
EXPENSES (Php)   EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)     EXPENSES (Php)		12,3 11.11	33,010.13	22, 137.03	
EXPENSES (Php)		252.540	236.025	206,430	
Fuel/Energy Cost         42,541.14         53,840.43         22,459.63           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191,810	(Php)				
Cost         42,341.14         33,840.43         22,439.03           Terminal Fee         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191,810	T. 1/E	EXPENS	SES (Php)		
Cost         18,000         18,000         18,000           Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191,810		42,541.14	53,840.43	22,459.63	
Dispatcher's Fee         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           Expenses         NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191,810					
Fee         2,160         2,160         2,160         2,160           Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         2,473,4563         2,242,494         2,191,810		18,000	18,000	18,000	
Maint./Repair Expenses         11,750         9,250         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191,810	-	2,160	2,160	2,160	
Expenses         11,750         9,230         6,000           Total Operating Expenses         74,451.146         74,564.432         48,619.630           NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         2,473,4563         2,242,494         2,191,810					
Total         74,451.146         74,564.432         48,619.630           Expenses         NET         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         2,473,4563         2,242,494         2,191,810	_	11,750	9,250	6,000	
Operating Expenses       74,451.146       74,564.432       48,619.630         NET INCOME       178,088.85       161,459.56       157,810.37         AVERAGE PERFOMANCE INDICATORS (Php)         Daily Gross Income       3,507.5       3,278.12       2,867.08         Daily Operating Expenses       1,034.0437       1,035.631       675.272         Expenses       2,473,4563       2,242,494       2,191,810					
Expenses         Income         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         2,473,4563         2,242,494         2,191,810		74 451 146	74 564 432	48 619 630	
NET INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         Daily Net         2,473,4563         2,242,494         2,191,810		74,431.140	74,504.452	40,017.030	
INCOME         178,088.85         161,459.56         157,810.37           AVERAGE PERFOMANCE INDICATORS (Php)           Daily Gross Income         3,507.5         3,278.12         2,867.08           Daily Operating Expenses         1,034.0437         1,035.631         675.272           Expenses         2,473,4563         2,242,494         2,191,810		1=0			
AVERAGE PERFOMANCE INDICATORS (Php)  Daily Gross Income 3,507.5 3,278.12 2,867.08  Daily Operating 1,034.0437 1,035.631 675.272  Expenses Daily Net 2,473,4563 2,242,494 2,191,810		178,088.85	161,459.56	157,810.37	
Daily Gross Income     3,507.5     3,278.12     2,867.08       Daily Operating Expenses     1,034.0437     1,035.631     675.272       Daily Net     2,473,4563     2,242,494     2,191,810					
Income 3,307.3 3,278.12 2,807.08  Daily Operating 1,034.0437 1,035.631 675.272  Expenses Daily Net 2,473,4563 2,242,494 2,191,810					
Operating Expenses         1,034.0437         1,035.631         675.272           Daily Net         2,473.4563         2,242.494         2,191.810		3,507.5	3,278.12	2,867.08	
Operating Expenses         1,034.0437         1,035.631         675.272           Daily Net         2,473.4563         2,242.494         2,191.810					
Expenses Daily Net 2 473 4563 2 242 494 2 191 810		1,034.0437	1,035.631	675.272	
1 / 4 / 3 4 3 6 3 1 / / 4 / 4 9 4 1 / 1 9 1 8 1 1 1					
Income 2,473.4303 2,242.434 2,191.810	Daily Net	2 173 1562	2 242 404	2 101 210	
	Income	2,473.4303	۷,۷ <del>4</del> ۷.474	2,171.010	

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As with Model A, the Fuel Cost, Operating Cost, and Net Income parameters were viewed on a passenger-kilometer basis.

**Table VII**Normalized Data for Phase 1 (Model B)

	Diesel	LPG	Electric
Fuel Cost (Php)	60,930.829	58,526.819	31,029.01
Net Income (Php)	99,952.13	93,261.26	96,073.65
Total No. of Passengers	18,279	17,225	14,686
Load Factor	0.6347	0.5981	0.6374
Total Length of Route (km)	13.25	13.25	13.25
Fuel Cost, Php per passenger-km	0.251570	0.256432	0.159462
Net Income, Php per passenger-km	0.68780	0.68103	0.82289

**Table VIII**Normalized Data for Phase 2 (Model B)

	Diesel	LPG	Electric
Fuel Cost (Php)	42,541.14	53,840.43	22,459.63
Net Income (Php)	178,088.85	161,459.56	157,810.37
Total No. of Passengers	18,279	17,225	14,686
Load Factor	0.6959	0.6974	0.6826
Total Length of Route (km)	20.8	20.8	20.8
Fuel Cost, Php per passenger- km	0.17798904	0.2228005	0.117199
Net Income, Php per passenger- km	0.74511073	0.7436952	0.8234884

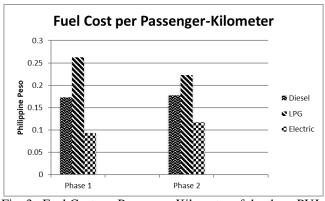


Fig. 3. Fuel Cost per Passenger-Kilometer of the three PUJ types in Phase 1 and Phase 2 using Model B.

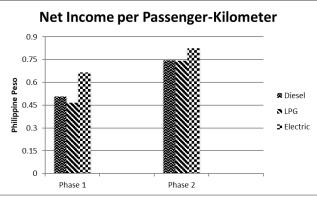


Fig. 4. Net Income per Passenger-Kilometer of the three PUJ types in Phase 1 and Phase 2 using Model B.

## IV. CONCLUSION

In both Models A and B, the more economical PUJ to use for both routes in terms of fuel cost per passenger-km is the Electric Jeepney, followed by the Diesel Jeepney, and lastly by the LPG Jeepney. The same order of preference can be said in terms of net income per passenger-km.

The methodology applied may also be done using other route variations for a more thorough analysis. Note that other factors, such as performance and emission analysis, logistics for alternative fuel types (i.e. charging stations, LPG Refueling Stations, etc) must also be taken into account when selecting the proper PUJ type to use per route.

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