RESEARCH REPORT

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Are Metro Manila Households Willing to Pay for Cleaner Public Transport?

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In Metro Manila polluted air is linked to almost 5,000 premature deaths each year. To help address this significant pollution and public health problem, a new EEPSEA study has looked at whether people in the city would be willing to pay for a program that would help clean up the city's traffic. This would involve the replacement of the city's current fleet of highly-polluting diesel jeepneys with zero-emission electric vehicles. Under such a scheme, households would pay through a surcharge on top of their monthly electricity bills.

The study is the work of Jamil Paolo S. Francisco from the Ateneo de Manila University in Quezon City. It finds that there would be some public support for the scheme, that it would provide significant financial benefits to the city and that people would be willing to pay to finance it. However, it also shows that the program would not be economically viable without government support. The study also investigates various issues linked to 'willingness to pay' research. It finds that using secret ballots can improve the validity of this kind of research and recommends that this method be used more widely.

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I offer this work to my mother, who has never really fully understood or perhaps even read any of my work but believes in it just the same.

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EXECUTIVE SUMMARY

To address the problem of air pollution in Metro Manila, the study proposes a jeepney buy-back program through which the current fleet of diesel jeepneys would be replaced with zero-emission electric vehicles. Households are made to pay for the program through a surcharge on top of their monthly electricity bill. A single-bound dichotomous choice contingent valuation approach using the referendum format is employed to estimate willingness to pay (WTP). The study arrives at WTP estimates for the program aimed at providing cleaner public transportation ranging from PHP 173.10 (USD 3.85) to PHP 259.75 (USD 5.77) per month. However, a simple cost-benefit comparison shows that the program remains economically unfeasible without government support, particularly due to the high cost associated with replacing the diesel fleet. Nonetheless, substantial aggregated benefits show that Metro Manila households are indeed willing to pay for improved air quality from cleaner public transport. Income, education and bid level are found to be significant determinants of WTP. The study also investigates the impact of using secret ballots for eliciting WTP responses to reduce yea-saying bias. Results show that the method of WTP elicitation influences WTP responses. WTP estimates from data gathered using the secret ballot technique were significantly lower than estimates from data gathered using the conventional face-to-face method.

1.0 INTRODUCTION

1.1 Background

In 2005, the World Health Organization and the United Nations Environment Program ranked Metro Manila, an urban agglomeration of 17 cities and municipalities that includes the Philippines capital city of Manila, as the fourth-most-polluted urban region in the world. A large proportion of the population is exposed to particulate matter, sulfur dioxide, total oxidants, carbon monoxide, and lead at levels above WHO guidelines. Estimates from the Philippines Environment Monitor 2007, a joint project between the World Bank and the Department of Environment and Natural Resources (DENR), show that there have been close to 5,000 premature deaths each year in Metro Manila due to respiratory and cardiovascular diseases from exposure to poor air quality.

Based on a 2003 emissions inventory, the DENR reports that mobile sources contribute to 70% to 90% of air pollution in the metropolis. The most important mobile sources include diesel-fueled vehicles and two-stroke gasoline engines. Among the main culprits are public utility vehicles – buses, jeepneys, and tricycles. An emissions inventory developed by Rolfe (2002) indicates that 49% of PM10 particulate matter emissions come from diesel-fueled utility vehicles (mostly jeepneys), 23% from trucks and buses, and 22% from motorcycles and tricycles. The number of diesel-fueled vehicles in the country had increased more than threefold from 330,000 in 1987 to over 1.3 million in 2002.

In recent years, much of the attention from both environment advocates and government authorities has focused on two-stroke tricycles because of their fuel inefficiency and emissions of hydrocarbons and particulate matter. On the other hand, jeepneys have generally been overlooked as a source of both air and noise pollution. This is unfortunate because jeepneys are found on practically all the major roads of Metro Manila. Jeepneys account for 12.9% of trips made by vehicle and for 39.1% of trips made by passengers (MMUTIS, 2000). Passengers are hazardously exposed to air pollution both on and off the vehicle since jeepneys are typically not air-conditioned. Of course, such motor-vehicle-generated pollution affects non-users as well. In a comprehensive report by the Manila Observatory (2005) on environment strategies for the Metro Manila transport sector, studies are cited as having shown no significant difference between PM10 levels inside and outside homes. This implies that both commuters and non-commuters alike are affected by motor-vehicle-generated pollution.

Year 2005 data from the Land Transportation Office (LTO) show that there are about 58,200 registered jeepneys (as opposed to 5,000 intercity buses and roughly 100,000 public-use tricycles) that ply the streets of Metro Manila. Many of these public utility jeepneys (PUJs) are powered by reconditioned diesel engines, most of which are of substandard quality (Colos, 2005). In their study, Vergel, Yai and Iwakura (2001) reveal that the majority of jeepneys on the road use engines made prior to 1992. According to the same study, as many as 40% of jeepneys use a particular engine model that has been out of production since 1984. It is generally accepted that older and poorly maintained engines tend to produce excessive pollution. This is further exacerbated by a common disregard for power-to-weight ratios and vehicle overloading.

1.1.1 The electric jeepney as a viable alternative

In 2007, two electric-powered jeepneys were introduced in Makati City as the pilot project of a joint program of Greenpeace and the Makati City Government. The so-called "e-jeepneys" are powered by 5-kW electric motors with batteries that, at full capacity, allow the vehicles to run distances of 120 to 140 kilometers at around 40 kilometers per hour. Twelve six-volt batteries are charged for eight hours on ordinary 220-volt power sockets at a cost of approximately PHP 200 (USD 4). In contrast, regular diesel-engine jeepneys guzzle about PHP 300 (USD 6) or more of diesel fuel each day. The electric jeepney can seat 12 to 14 passengers. Each vehicle is said to cost about PHP 625,000 (USD 12,500). As with all electric vehicles, the e-jeepney runs very quietly and produces zero emissions.

Operating the electric jeepney is expected to cost less than its diesel-powered counterparts. However, the actual cost of buying the new vehicle is greater by approximately PHP 150,000 (USD 3,000) than the cost of a newly assembled jeepney with a reconditioned diesel engine. This is the main challenge to the viability of the electric jeepney. The savings generated in terms of operating cost may not be enough to enable PUJ operators to switch to the new vehicle and replace their current units.

A comprehensive government program is needed to promote the electric jeepney. At present, the national government has yet to develop such a program. In 2002, a national program promoting the use of compressed natural gas (CNG) as an alternative fuel for public transport was implemented under E.O. 290, establishing the Natural Gas Vehicle Program for Public Transport (NGVPPT). The program included a long list of incentives including tax breaks to investors, preferential franchise issuances to operators, exclusive franchises on new routes, affordable financing from government financial institutions, and subsidies on CNG fuel. Elements of NGVPPT may be borrowed in developing a similar program for the promotion of electric jeepneys. However, dissimilarities in the business model and political economy of the bus sector versus that of the jeepney sector, present an additional challenge.

Unlike the relatively large transport companies that operate buses, jeepney operators tend to be small, family-run enterprises with limited resources. This makes it particularly difficult to convince and enable jeepney operators to switch to the new electric vehicle. At current market prices, the value of a used diesel jeepney ranges from PHP 400,000 for units less than five years old to PHP 150,000 for units more than fifteen years old, an average of PHP 275,000 (USD 5,500). On the other hand, the new electric vehicle costs PHP 625,000 (USD 12,500), creating a difference of PHP 350,000 (USD 7,000). The difference is largest for those operating older jeepneys, the ones that generate the most pollution and therefore the ones that are in greatest need of replacement.

1.1.2 Proposed buy-back program for diesel jeepneys

In order to provide not only an incentive but also, more importantly, practical support for PUJ operators to replace their old, diesel-powered vehicles, this study proposes a mandatory jeepney buy-back program, aimed at enabling PUJ operators to retire their diesel fleets and replace them with electric jeepneys. In this program, the government will pay PUJ-owners a lump sum of PHP 300,000 (USD 6,000) for their diesel vehicles to be retired and converted to scrap. The lump-sum payment is expected to generate significant incentive and support for PUJ-operators to replace their diesel vehicles.

The Land Transportation Franchise and Regulatory Board (LTFRB) currently issues five-year renewable franchises to PUJ operators. When this program is adopted, the LTFRB will not renew franchises for diesel-fueled jeepneys. Therefore, within five years, all PUJs in Metro Manila will have to be electric if they are to continue servicing their routes.

The PHP 300,000 lump sum paid to jeepney owners/operators who take advantage of the program will serve as a conditional subsidy. The remaining balance of the cost of the new vehicle will have to be shouldered by the jeepney owners/operators themselves. Financing schemes at competitive interest rates will be available through private banks and government financial institutions. Meanwhile, the LTRFB will not allow any fare increases intended to cover the cost of purchasing the new electric vehicles.

It would cost some PHP 17.46 billion to extend the proposed buy-back program to the entire fleet of 58,200 diesel PUJs. Given the national government's fiscal constraints, it is unlikely that it can afford to implement the buy-back program on its own. To support the program, the study proposes that the government set-up a fund supported by monthly contributions from Metro Manila households through a fee added on to their electricity bills. After all, these households face both real and perceived health hazards (e.g. respiratory ailments such as bronchitis, asthma attacks and allergies) from exposure to air pollution as well as the inconvenience brought by the unsightliness of black fumes, smog, and soot that clings to buildings.

The strength of household support for the proposed buy-back program is the subject of this contingent valuation (CV) study. Households were asked whether they will vote in favor of being made to add a specified amount of money to their monthly electricity bill to support the program and therefore enjoy the benefits of an expected improvement in air quality following the adoption of electric jeepneys.

1.1.3 Air quality improvement due to cleaner public transport

The full replacement of all diesel jeepneys with electric vehicles is expected to result in a 50% reduction of PM emissions. This reduction is about the same difference between the levels of pollution on major roads during the morning rush hour versus the early afternoon off-peak hours. Everyone in Metro Manila, both users and non-users of public transport alike, are expected to feel the benefits of this drop in air pollution. This expected improvement in air quality is derived from projections of a comprehensive 2005 report by the Manila Observatory on the impacts of Integrated Environmental Strategies (IES) focusing on the transport sector that analyzed the air quality and health impacts of several transport-and fuel-related measures on emissions. This study calculated total emissions under various policy alternatives as:

Emissions = f (travel distance, travel speed, emission factors) (Equation 1)

Travel distances and vehicle speeds were estimated using the four-step travel demand forecasting model using JICA STRADA software. Vehicle-and speed-specific emission factors of PM were used in the estimation. These emission factors were borrowed from various earlier studies, such as the ADB VECP (2002), MMUTIS (1999), and JSPS Manila Project (2002).

Among 12 traffic-and fuel-related policy measures analyzed, one particular policy option involving the use of coco-methyl ester (CME) as a diesel substitute for jeepneys is used as a basis for expectations of air quality improvement from the proposed buy-back program. One reason for this is that the CME policy scenario was the only one that involved jeepneys exclusively. Secondly, similar to the proposed buy-back program, the use of CME-blended fuel was expected to reduce PM emissions. Based on research, the IES report predicted a 40% reduction in the PM emission factor of jeepneys if diesel fuel were blended with CME. Two scenarios were developed for the CME policy alternative: a “low” scenario with only 2% of the jeepney fleet switching to CME-blend fuel by 2010 and a “high” scenario with 4% switching to CME. Using the IES estimates for the high scenario of the CME alternative,

adjusting for a 100% reduction in emissions for every diesel jeepney replaced with an electric vehicle, and then finally adjusted to reflect full fleet replacement yield, there was an expected air quality improvement equal to a 50% reduction in PM emissions.

The estimated air quality improvement of retiring the old diesel fleet and replacing it with e-jeepneys is compatible with the findings of Rolfe's (2002) emissions inventory that attributed 49% of PM emissions to jeepneys. This expected air quality improvement was presented to survey respondents to give them a quantitative representation of the expected benefits of the proposed buy-back program.

1.2 Research Objectives

The specific objectives of this study are as follows:

1. To estimate the value of cleaner public transport to Metro Manila households as reflected in their WTP for a mandatory jeepney buy-back program;
2. To estimate the costs of the buy-back program and compare this with the benefit estimates of cleaner air;
3. To compare WTP estimates using a secret ballot to elicit the WTP response, versus the traditional face-to-face technique of interviews; and
4. To provide recommendations on factors affecting Metro Manila households' willingness to support the proposed jeepney buy-back program.

1.3 Significance of the Study

From a policy perspective, it is believed that a survey of household attitudes towards motor-vehicle generated air pollution and an economic valuation of the perceived benefits of cleaner public transport (particularly PUJs) are crucial in determining the feasibility of adopting the electric jeepney in Metro Manila. A comparison of costs and benefits will determine the viability of e-jeepneys as a solution to the problem of air pollution in Metro Manila. Such a study will aid the government in evaluating public attitudes towards the electric jeepney in particular, and towards programs aimed at promoting cleaner public transport in general.

From an academic standpoint, the comparison of WTP estimates derived from a secret ballot technique and the traditional face-to-face method of eliciting WTP responses provides insights regarding the possibility of reducing hypothetical bias in general and yea-saying bias in particular.

2.0 REVIEW OF RELATED LITERATURE

2.1 CV Methodology: General Issues

Contingent Valuation (CV) is a stated preferences approach to the valuation of non-marketed goods that uses surveys to elicit willingness-to-pay (in the case of positive changes in the environment) or willingness-to-accept (in the case of negative changes). CV surveys present scenarios that offer different possible future government actions, and ask respondents to state their preferences from those actions. The choices made by survey respondents among the hypothetical scenarios are then analyzed in the same way as the choices made by consumers in actual markets (Carson, 1999).

The most commonly used format of the CV approach offers the survey respondent a binary choice between the status quo and an alternative policy scenario that costs more than maintaining the status quo. The respondent is told that the government will impose the higher cost if the alternative scenario is implemented. A willingness-to-pay (WTP) question is asked and the respondent provides a “favor/not-in-favor” response. A crucial element of the CV survey is a thorough discussion of the alternative scenario regarding what it will provide, how it will be provided, and how much it will cost (Carson, 1999).

There are several technical issues in the use of CV methods in general. These issues concern (1) the hypothetical nature of the CV question; (2) potential bias generated by "strategic" responses; and (3) the possible biases generated by design flaws in the survey instrument.

The hypothetical nature of the CV question has long been a major focus of debate on the reliability of CV methodology. How a respondent answers a hypothetical CV question might not accurately reflect his true response faced with the real situation. For one, critics are afraid that respondents may answer CV questions with a “warm-glow” by which they get moral satisfaction from the act of paying for the good/service regardless of the characteristics of the actual environmental good. Responses on WTP may be motivated by the utility derived from the mere act of “doing charity” or “doing the right thing”.

Two approaches have become popular in mitigating hypothetical bias. One approach involves the use of a “cheap talk script” in which hypothetical bias is explicitly discussed with respondents prior to asking the WTP question. Cummings and Taylor (1999) provided evidence of the effectiveness of this approach but subsequent studies (Brown et al., 2003; Murphy et al., 2005) have shown mixed results. The other widely used approach is through the use of a certainty scale whereby respondents are asked to rate how certain they are about their responses to the WTP question on a scale of one to ten (Champ et al., 1997). Comparing responses to hypothetical dichotomous choice questions about donating a specified amount to a public good with actual donations to the public good, Champ et al., found that although hypothetical donations significantly exceeded real donations, there was no significant difference when only subjects that were very certain of their yes response were counted as real yes responses. However, the problem with using a scale to assess certainty is that it is necessary to estimate the cut-off level of certainty at which a hypothetical decision corresponds to a real decision.

Strategic bias is another issue in CV studies. Strategic responses to the CV question may be in the form of “yea-saying” or “nay-saying”. Nay-saying occurs when the respondent provides a no response to an amount asked even though WTP is greater than the amount proposed. Saying “no” may be a strategic response so that should the alternative policy or non-status quo condition be implemented, the respondent would not have to pay the full amount he/she is truly willing to pay. Yea-saying occurs when a respondent says yes to an amount in order to please the interviewer even though the respondent's WTP is less than the amount proposed.

There are also issues regarding the choice of format for the CV question. One of the earliest formats is the open-ended protocol used by Davis (1963) where the respondent is simply asked how much he is willing to pay for the alternative scenario to be implemented. The problem with the open-ended format is that it was subject to unrealistic bids that became outliers, making analysis and value estimation more difficult, if not questionable. The binary choice format, where the researcher provides a specific cost value to which the respondent makes a "favor/not-in-favor" response is most commonly used. Developed by Hanemann (1984), this referendum format offers each respondent a single bid price, but offers different bids to different respondents, and then from this, traces out the distribution of WTP. The economic value of the good is then estimated as the Hicksian consumer surplus net of the price paid.

An advantage of the referendum format is that responses are bound by the researcher's questions, allowing him to exclude unrealistic bids (Kimenju et al., 2005). However, Green, Jacowitz, Kahneman and McFadden (1998) warned that the referendum format is vulnerable to "anchoring" whereby respondents rely too heavily on a specific piece of information, such as the promised improvement in environmental quality, failing to consider other important information such as the opportunity costs of having to pay for the improvement.

The reliability of CV estimates also depends on sampling methodology and survey design. A sample size of several hundreds to a few thousands is often recommended (Carson, 1999). Careful construction of the survey instrument and extensive pre-testing minimizes the possible biases that may be caused by the issues discussed. As for the design of the survey instrument, the good and the scenario under which it would be provided should be described clearly and accurately, and the trade off that the respondent is asked to make should be a plausible one. The respondent should be provided with enough information to make an informed decision but not be overwhelmed by it (Carson, 1999).

2.2 Eliciting WTP and the Use of Secret Ballots

Personal interviews are typically recommended partly because visual materials such as maps and pictures that facilitate respondent understanding can be used. However, this face-to-face method may give rise to distortions, particularly since the answers to the questions asked are not secret, i.e. at least one person, the interviewer, knows what the respondent has said (Eysenck, 1998). It is possible to assess the significance of this secrecy factor using a split-sample technique in which half of the respondents are interviewed in the conventional way, while the other half use a secret ballot to mark their responses.

In public opinion polls, the use of secret balloting has gained much popularity among researchers, particularly when asking about beliefs, opinions, preferences or behaviors that respondents might prefer to keep confidential (Krosnick et al., 2002). Studies such as Nederhof (1984), Presser and Stinson (1988), and Tourangeau, Rips and Rasinski (2000) show increased reporting of socially undesirable behaviors and decreased reporting of social desirable behaviors when self-administered ballots are used. Turnbull (1944) was one of the first to have used a secret-ballot technique in a public opinion poll to counter the possibility that the respondent may be "suspicious, embarrassed, nervous, inarticulate, irritated, hostile or patronizing". In this technique, the interviewer carried a padlocked box prominently marked "secret ballot". A total of 612 respondents were asked 10 questions.

Three hundred were asked by means of the conventional interview technique while the other respondents were asked to mark their ballots privately and to drop their completed ballots in the box. Turnbull found that the use of secret ballots did produce marked differences in certain conditions, particularly when questions dealt with high social prestige or when they involved controversial matters.

3.0 FRAMEWORK AND RESEARCH METHODOLOGY

3.1 Analytical Tools

3.1.1 Parametric estimation

Following Kristöm and Riera (1997), let consumer utility u(z,q) be a function of the state of the environment z and composite good q. The consumer maximizes his utility subject to a budget constraint y = pq where the price of q is normalized to one. Solving for the consumer's indirect utility function yields V(z,y), letting z_i (i=0,1) be the state of the environment in i, and using the indirect utility function, WTP can be defined as:

$$V(z_1, y - wtp) = V(z_0, y) \qquad \text{(Equation 2)}$$

Willingness to pay for an improvement in the state of the environment from z_0 to z_1 thus corresponds to the compensating variation that will make a consumer as well-off with the new state of the environment and the new income as with the old state of the environment and the old income.

Under the framework of the random utility theory (McFadden, 1974), indirect utility can be written as: $U_{ij} = V_{ij} + \varepsilon_{ij}$ (Equation 3)

The utility that person i derives from choosing alternative j is written as U_{ij}, where V_{ij} is the deterministic component of utility and ε_{ij} is a stochastic element that represents unobservable influences on consumer choice.

In the binary choice format of the CV method, two alternatives are presented to the consumer, an improved state j and the status quo k. Following Hanemann (1984), the probability that a consumer prefers option j or k is:

$$P_{ij} = P(\varepsilon_{ij} - \varepsilon_{ik} < V_{ik} - V_{ij}) \qquad \text{(Equation 4)}$$

$$P_{ik} = P(\varepsilon_{ik} - \varepsilon_{ij} < V_{ij} - V_{ik}) \qquad \text{(Equation 5)}$$

Assuming that each random term is Type I extreme value distributed, the probability of the consumer choosing alternative j is:

$$P_{ij} = 1/(1+e^{-\omega(V_{ik} - V_{ij})}) \qquad \text{(Equation 6)}$$

This is then estimated using Hanemann's binary logit model where ω is normalized to one. Dichotomous choice WTP responses are regressed on bid values and a vector of socio-economic and awareness/attitudinal variables using a logistic function (Hanemann, 1989):

$$Pr(Yes) = E(Y=1/X_i) = 1/(1+e^{-[\beta_0+\beta_1 X_i]}) \qquad \text{(Equation 7)}$$

where *X*i is a vector of determinants including the bid price.

Mean willingness to pay is calculated according to the equation:

$$WTP = -\alpha/\beta_1 \quad \text{(Equation 8)}$$

where α is the sum of the constant term and the coefficients of all explanatory variables except price multiplied by their respective mean values and β_1 is the coefficient of the bid price.

3.1.2 Non-parametric estimation

Non-parametric mean willingness to pay was calculated using the lower bound Turnbull formula (Haab and McConnell, 2003):

$$E_{LB}(B) = \sum_{j=0}^{M} Bj(F_{j+1} - F_j) \quad \text{(Equation 9)}$$

$$V(E_{LB}(B)) = \sum_{j=1}^{M} Fj(1 - F_j)(B_j - B_{j-1})^2/T_j \quad \text{(Equation 10)}$$

where M is the number of bids; B is the bid level; *T*j is the number of respondents offered the bid price B_j; F_j is the proportion of "No" responses to the bid price B_j; $F_0 = 0$ and $F_{M+1} = 1$.

3.2 Pre-test and Pre-survey Activities

Prior to conducting the main survey, a total of four separate focus-group discussions (FGDs) and a pre-test of 100 samples were completed for purposes of data gathering and to aid in the development of the CV scenario, survey instrument and survey method. The first FGD was with representatives from the Institute for Sustainable Cities, the leading proponent of the electric jeepney, together with regular users of public transport and non-public transport users. Discussions revealed that both users and non-users of public transport were very interested in emissions-free public utility vehicles. A major issue raised was whether jeepney drivers and operators would respond positively to any program aimed at replacing their current diesel-powered jeepneys with electric vehicles. To find out, a separate FGD with jeepney operators and drivers was conducted in Makati City, where several e-jeepneys have been introduced and are now servicing a specially designated route within the central business district. All participants said that air pollution was indeed a problem and the group voluntarily admitted that jeepneys were a primary contributor to air pollution. When asked about whether they would voluntarily replace their current vehicles with electric jeepneys, given the lower operating costs and health benefits the e-jeepney promised, the group unanimously said that although they believed in the benefits of the new electric vehicle, they simply did not have the financial resources to afford it.

Draft questionnaires were presented to the last two FGDs with representatives of the target population. Among the points discussed were the acceptable range of bids that would be used to elicit WTP, awareness of the health risks associated with air and noise pollution, attitudes and sentiments towards such pollution, notable experiences of pollution while commuting, and general commuting habits.

The questionnaire and accompanying visual aids were subjected to a pilot test to evaluate their effectiveness. The pre-test was conducted from December 2009 to January 2010 in two adjacent *barangays* (districts) in the City of San Juan, Metro Manila.

A total of 100 households were surveyed. During the first two weeks of the pilot test, the proposed modified drop-off technique proved to be largely ineffective. In the originally proposed drop-off method, the surveyor was to select a household at random, introduce himself and the study, leave a survey kit including a self-administered questionnaire to be completed by the head of the household, arrange for pick-up in the next two to three days, and return to retrieve the completed questionnaire. Although nearly all households that were approached accepted the survey kits when dropped-off, almost none had completed the questionnaires by the time they were supposed to have been ready for pick-up. The surveyor was often told to return again a few days after the pre-arranged pick-up date, only to find questionnaires unfinished or obviously rushed, often with multiple questions left unanswered. Realizing the difficulty in implementing the drop-off technique and the poor quality of the survey results it yielded, the research team decided to switch to interviews. All forms collected using the drop-off protocol were discarded upon the adoption of the new survey technique.

In summary, the issues addressed through feedback from FGDs and pre-testing included the practicality of the CV scenario (voluntary vs. mandatory buy-back), bid levels, payment vehicle (electricity surcharge vs. other means), and the survey method (drop-off vs. in-person interviews).

Four enumerators, including the field supervisor, conducted the main survey from February to June 2010. Each enumerator was required to attend an intensive three-day training workshop. On the first day of training, the scope and objectives of the research study were discussed, followed by a technical briefing on CV method. This was then followed by a workshop on survey techniques and how to properly administer the survey instrument based on Whittington's recommendations on improving the performance of CV studies in developing countries (2002). Enumerators were then asked to perform role-playing exercises to practice their delivery of the survey script. On the second day, enumerators were brought to the field for practice interviews with actual respondents. Each enumerator had to be accompanied by the field supervisor at least once as he conducted an in-person interview with a randomly selected household. Enumerators were asked to conduct three interviews each. At the end of the day, completed questionnaires were collected and checked. On the last day, the field supervisor discussed his evaluation of each of the enumerators with the group. Questions and ideas on how to best conduct the survey were then shared in a final FGD, together with rest of the research team.

Essential secondary data was gathered through correspondence with the Institute for Sustainable Cities (ISC) – the main proponent of the electric jeepney in the Philippines – as well as from government agencies including the EMB, DENR, DOTC, and the City Government of Makati. Meanwhile, data on motor-vehicle-generated pollution in Metro Manila, emission factors, the adverse health effects of emissions and their corresponding economic impacts were sourced from a report by the Manila Observatory on Integrated Environment Strategies (2005), which focused on the Philippines transport sector.

3.3 Sampling Procedure

The main household survey was conducted in Metro Manila, the national capital region of the Philippines, with a population of 11.5 million in 2007. Covering an area of 636 km^2, Metro Manila is the smallest of the country's 17 regions but is the most densely populated (18,166 people per km^2) and the most urban. It is also the region with the highest densities of road traffic. The urban agglomeration consists of 16 cities and one municipality.

Respondent households were drawn from the five largest cities in Metro Manila in proportion to their population sizes, relative to the total population of Metro Manila. The cities included in the survey were Quezon City (21% of the Metro Manila population), Manila (15%), Caloocan (11%), Makati (5%) and Pasig (5%). These cities also have the most congested roads and busiest transport hubs. A total of 1,000 households were sampled – 500 households for Group A (conventional WTP elicitation) and 500 for Group B (secret ballot technique). Keeping to the relative sizes of the five chosen sample cities, the following numbers of respondents were drawn per city for each of the two sample groups:

Table 1: Household sampling

	Relative Size	**Group A**	**Group B**
Quezon City	37%	185	185
Manila	26%	130	130
Caloocan	19%	95	95
Makati	9%	45	45
Pasig	9%	45	45
TOTAL	100%	500	500

Respondent households were drawn using systematic random sampling. Barangays were randomly selected from a list of each of the five cities. Once each chosen barangay was exhausted, another barangay was randomly selected from the list until enough households were sampled per city. Using basic road maps, starting points were identified from which surveyors were asked to count-off to the 10^{th} house from each starting point. If the 10^{th} household declined to participate, the surveyor proceeded to the next house. After a successful interview, the surveyor had to count-off to the 10^{th} house thereafter, and so on.

3.4 Survey Instrument and CV Question

The survey instrument had the following components:

(1) an introductory section to help explain the general context of the study;
(2) awareness and attitudinal questions on the current state of public transportation and the level of vehicle-related pollution;
(3) questions on commuting habits and past commuting experiences;
(4) a detailed description of the alternative to be offered to the respondent, the institutional setting which the good will be provided, and the manner in which the good will be paid for;
(5) a brief discussion of CV method intended to make respondents aware of possible biases in their answers;
(6) the actual CV question;
(7) a set of debriefing questions about why respondents answered certain questions the way they did, and
(8) a final section requesting socio-economic information. The two sample groups were given essentially the same survey instrument, except for a modification in the way the CV question was presented to Group B, that used a secret ballot technique in eliciting the "in-favor/not-in-favor" response to the referendum question. Respondents were allowed to choose between English (see Appendix 1) and Tagalog versions of the questionnaire.

(8) a final section requesting socio-economic information. The two sample groups were given essentially the same survey instrument, except for a modification in the way the CV question was presented to Group B, that used a secret ballot technique in eliciting the "in-favor/not-in-favor" response to the referendum question. Respondents were allowed to choose between English (see Appendix 1) and Tagalog versions of the questionnaire.

This study employs the referendum-style single-bound dichotomous-choice question format. Five different bid levels were used to trace out the distribution of WTP. The following bid levels were randomly assigned to respondents: PHP 50 (USD 1.11), PHP 100 (USD 2.22), PHP 250 (USD 5.55) PHP 500 (USD 11.11) and PHP 750 (USD 16.67).

For Group A (conventional method), the following CV question was asked:

Suppose that we were to have a referendum on this program now. If more than half of the people vote 'YES', and the referendum is passed, the buy-back program will be implemented and households like yours will be made to pay an additional PHP XXX.XX on top of your monthly electricity bill every month for 60 months or five years to fund the program. On the other hand, if more than half of the people vote 'NO', then the program will not be implemented and no additional surcharge will be collected.

Consider your household income and expenditure, and remember that having to pay this additional amount, if the referendum is passed, will leave you with less money for, for example, food, clothing, transportation, and savings. Suppose that we were to take a secret vote now. Would you vote for this program?"

The respondent provided an "in-favor/not-in-favor" response, communicated directly to the enumerator. Those who responded positively to the CV question were asked to rate the certainty of their responses on a scale of 1 to 10, 10 being "definitely sure" and 1 being "not sure at all". Debriefing questions were then asked to determine the reasons for the respondent's positive or negative response.

For Group B (secret ballot), the respondent was given a ballot on which he/she was instructed to indicate his/her vote on the referendum, which asked:

Suppose that we were to have a referendum on this program now. The use of secret balloting will ensure that no one will find out who voted for or against the program. You will be given a ballot on which you can cast your vote. You will then be asked to drop your ballot into this ballot box.

<<Enumerator gives ballot and shows locked/sealed ballot box>>

In this referendum, if more than half of the people vote 'YES', and the referendum is passed, the buy-back program will be implemented and households like yours will be made to pay an additional PHP XXX.XX on top of your monthly electricity bill every month for 60 months or five years to fund the program. On the other hand, if more than half of the people vote 'NO', then the program will not be implemented and no additional surcharge will be collected.

Consider your household income and expenditure, and remember that having to pay this additional PHP XXX.XX, if the referendum is passed, will leave you with less money for, for example, food, clothing, transportation, and savings.

Suppose that we were to take a secret vote now. Would you vote for this program? Please mark the appropriate box on your ballot.

As a follow-up question, the respondent was asked to rank from 1 to 10, 10 being the highest, how sure he was about the vote he had cast. He was then asked whether he had doubts about the vote he had cast and if so why.

3.5 Protest Bids and Certainty Calibration

Questionnaires from Group A (conventional method) were screened for protest responses. Respondents who answered "no" to the WTP question were asked to give their reasons for rejecting the proposal. Those who cited reasons other than financial constraint were considered protest bids. These reasons included disapproval of the proposed buy-back program, distrust of the government, and doubts over the proposed program and/or research survey. A total of 33 out of 500 respondents (6.6%) in Group A were classified as protest bids.

To mitigate hypothetical bias, respondents from both groups were asked to rate how certain they were about their responses on a scale of 1 to 10, with 10 being "definitely sure" and 1 being "not sure at all". After comparing results using various cut-off certainty levels and heeding the recommendations of Poe et al. (2002) and Whitehead and Cherry (2004), only positive responses given a certainty rating of 7 and above were counted as "true" yes responses. Responses given a certainty rating of 6 and below were counted as "no" responses.

4.0 RESULTS AND DISCUSSION

4.1 Respondent and Household Characteristics

Table 2 describes some of the socio-economic characteristics of respondents. The mean age of respondents was 42.39. Two-thirds of the respondents were female. On average, respondents had completed 11-12 years of schooling, which is equivalent to having had some college education. The average monthly income was PHP 15,857.50 (USD 352.39). The average monthly electricity bill was PHP 2,037.81 (USD 45.28), which amounts to 13.2% of monthly income.

Table 2: Respondent and household characteristics

Variable	Description	Group A	Group B	Pooled Data	
		Mean	Mean	Mean	Std. Dev.
Age		43.37	41.40	42.39	13.44
Sex	= 1 if male, 0 if female	0.32	0.34	0.33	0.47
Status	= 0 if single, 1 if married, 2 if widowed	1.82	1.81	1.81	0.53
Educ.	Number of years of schooling	11.50	11.30	11.40	2.50
HH size	Number of household members	5.36	5.84	5.60	2.80
Meralco	Monthly electricity bill	2,064.20	2,011.43	2,037.81	1,832.44
Income	Monthly household income	15,870.00	15,845.00	15,857.50	14,393.72

4.2 Survey of Public Transport Use

Table 3 summarizes information gathered on public transport use and commuting habits. Close to 68% of respondents reported that they regularly use public transportation. Among several modes of transport, jeepneys were used by the largest proportion of public transport users (96%), followed by tricycles (76%) and buses (60%). The largest proportion of users (48%) commute during rush hour (between 7:30 a.m. to 10:30 a.m. and 3:00 p.m. to 7:30 p.m.) as defined by the Metro Manila Development Authority. Among several reasons for using public transportation, 74% of public transport users cited not having their own vehicle and public transport being the only available means of transportation for them. Sixty-five percent (65%) of total respondents reported using jeepneys on a regular basis. Eighty-one percent (81%) of those who regularly used jeepneys cited the lower cost of using jeepneys versus other modes of public transport as their reason for using them. On the other hand, 64% of users cited jeepneys as being the only mode of public transport servicing the routes they take, while 52% of users cited the convenience of jeepneys – being able to get on or off at any point without having to use designated stops as the reason for their modal choice. The FGDs produced similar results regarding the preference for jeepneys over other modes of transport. On average, jeepney users made 2.1 trips on jeepneys every day.

4.3 Awareness, Attitudes and Perceptions

Garbage was ranked as the most pressing environmental problem in Metro Manila by the largest proportion of respondents (45%), followed by air pollution (32%) and traffic congestion (16%). Only 2% of respondents considered the pollution of rivers and of Manila Bay as the most important environmental issue. The environmental problem ranked as most important by the smallest proportion of respondents was groundwater depletion (1%). These results, summarized in Table 4, suggest that Metro Manila residents are primarily concerned with environmental problems that are directly observable and explicitly experienced in the metropolis. The problems of improper and inadequate waste management, air pollution and traffic congestion are indeed more perceptible to Metro Manila residents compared with water pollution and groundwater depletion.

Among several public transport concerns, the largest proportion of respondents (46%) ranked air pollution from vehicle exhausts ("usok") as most important, followed by high public transport costs (23%), and lengthy travel times (18%). These three issues were also reported as the most important concerns in the FGDs with Metro Manila residents and public transport users. However, in the FGDs, high transport costs were considered most urgent.

Table 3: Public transport use

Description	Pooled
General Public Transport Use	
Regularly uses public transportation	67.79%
Regularly uses specific mode:	
Bus	59.67%
Jeepney	96.12%
Taxi	57.95%
Ferry	5.21%
LRT/MRT (mass transit system)	56.74%
Tricycle	76.45%
Shuttle	21.50%
Time of public transport use:	
Before 7:30 a.m.	37.83%
7:30 a.m.-10:00 a.m., 3:00 p.m.-7:30 p.m.	47.57%
10:00 a.m.-3:00 p.m.	32.91%
After 7:30 p.m.	11.85%
Reasons for taking public transport:	
Only means of transportation available	73.84%
Convenience, don't have to worry about driving or parking own vehicle	18.17%
Cheaper to use public transport than to use own vehicle	19.29%
Jeepney Use	
Regularly use public utility jeepneys	64.92%
Reasons for taking jeepneys:	
Only form of public transport available on routes taken	64.01%
Convenience, can get on or off at any point without having to use designated stops or transit stations	52.45%
Cheaper than other modes of public transport	81.08%

Table 4: Importance of environmental problems and public transport concerns

Problem	Pooled Data
Environmental Problems	**Ranked #1 in importance (%)**
Garbage	44.81%
Air pollution	31.98%
Noise	3.49%
Pollution of rivers and Manila Bay	2.36%
Traffic congestion	15.83%
Groundwater depletion	1.02%
Concerns about Public Transport	
High cost of transportation	22.90%
Limited number of buses, jeepneys, taxis	0.81%
Air pollution; black fumes	46.03%
Long queues and waiting time	3.56%
Long travel time	17.69%
Noise pollution	4.50%
Safety; security of personal belongings	3.78%

Survey results show that Metro Manila residents are highly knowledgeable about air pollution, its harmful effects on their health and its primary sources (Table 5). Almost 100% of respondents knew that air pollution increases the risk of cardiovascular and respiratory diseases. Meanwhile, 98% of respondents knew that vehicle exhaust emissions are the biggest source of air pollution in Metro Manila and 97% knew that much of the pollution from vehicles comes primarily from buses and jeepneys that run on diesel fuel. However, only 66% knew about the Clear Air Act and that it mandates the government to impose air quality standards. Only 62% knew about the Environment Management Bureau (EMB) and its task to develop a program to achieve and maintain air quality/emissions standards. People's unfamiliarity with the Clean Air Act is worrying given that this law was passed in 1999.

Table 5: Knowledge of health effects, sources and government policy on air pollution

Statement	Pooled Data
Air pollution increases the risk of cardiovascular and respiratory diseases such as bronchitis and asthma attacks.	99.90%
Vehicle exhaust emissions are the biggest source of air pollution in Metro Manila.	97.95%
Much of the pollution from motor vehicles comes from buses and jeepneys that run on diesel fuel.	96.64%
The Clean Air Act mandates government to impose air quality and emissions standards.	66.21%
The Environment Management Bureau (EMB) under the DENR is tasked to develop a comprehensive program to achieve and maintain air quality standards.	62.03%

Respondents' attitudes towards pollution in Metro Manila and government policy are summarized in Table 6. The percentages of those who "strongly agree" and "agree" with the statements given are tabulated. Most residents strongly agree (40%) or agree (55%) that traffic congestion is a problem in Metro Manila. They also strongly agree (39%) or agree (58%) that air quality along roads and highways is poor. Sixty-five percent (65%) strongly agree that the pollution coming from vehicle exhausts is harmful to people's health. Not surprisingly, a majority of respondents either strongly agree (57%) or agree (40%) that smoke-belching vehicles should be reprimanded and penalized.

Respondents rate the level of air pollution in Metro Manila as "poor", with 99% of respondents saying that air pollution is a problem (Table 7). A large majority (65%) of respondents do not believe that the government is doing enough to address the problem, which respondents generally consider "very important". Similar opinions were gathered from the FGDs, with participants observing that many buses and jeepneys seem to be able to get away with belching out smoke despite the law. Interestingly, some FGD participants said that perhaps promoting greener technologies such as through the use of cleaner fuels might be a better solution than monitoring/abating "dirty" technology.

Table 6: Attitudes

Statement	Strongly Agree	Agree
Metro Manila roads are too congested; traffic is a problem.	39.96%	54.72%
The air quality along Metro Manila roads is poor.	38.82%	58.33%
Smoke-belching vehicles should be reprimanded and penalized.	56.84%	39.98%
Metro Manila roads are too noisy.	35.59%	58.88%
Pollution from the exhausts of motor vehicles is harmful to people's health.	65.45%	34.04%
The major sources of vehicle-related air pollution in Metro Manila are public utility buses, jeepneys, and tricycles.	48.28%	49.28%

Table 7: Perceptions

Statement	Pooled Data
How would you rate the level of air quality in Metro Manila? Very good = 2, good = 1, tolerable = 0, poor = -1, very poor = -2	-1.09
Do you think air pollution is a problem in Metro Manila? Yes = 1, no = 0	98.78%
Do you believe the government is doing enough to improve air quality? Yes = 1, no = 0	34.99%
How would you rate the importance of reducing air pollution in Metro Manila? Very important = 4, important = 3, not very important = 2, not important at all = 1	3.89

Respondents who said that reducing air pollution in Metro Manila is important or very important (a total of 99%) cited the reasons listed in Table 8. Almost all respondents (99%) cited the hazards caused by air pollution to their health. A large proportion (89%) also cited harmful effects on nature and the environment, while 83% cited the unsightliness of fumes and smog.

Table 8: Reasons for stating that reducing air pollution is important or very important

Statement	Poole Data
Pollution is harmful to nature and the environment.	89.20%
Fumes and smog are visually unappealing to me.	82.95%
Air pollution is hazardous to my health.	99.49%

4.4 Willingness to Support and the Effects of WTP Elicitation Method

Almost all respondents (99%) think that air pollution is a problem in Metro Manila and that reducing the level of air pollution is important or very important. Presented with the proposed diesel jeepney buy-back program, aimed at cutting PM emission levels by half, are Metro Manila residents willing to pay for the promise of cleaner air?

Figure 1 shows the distribution of "yes" responses at the five bid levels (PHP 50, PHP 100, PHP 250, PHP 500 and PHP 750). The difference in proportions of yes responses between the two groups are especially pronounced at the higher bid levels, particularly at the PHP 500 bid level where 27% of respondents from Group A voted "yes" compared with 14% in Group B, and at the PHP 750 bid level where 12% in Group A voted "yes" versus only 6% in Group B. These results suggest that the method of eliciting WTP (conventional vs. secret ballot) may have an impact on WTP estimation, as those asked face-to-face might be more likely to respond positively than those who voted via secret ballot as they try to give the more "socially desirable" response (as in Levitt and List, 2007).

The outcome parallels the findings of other studies that employ time-to-think treatments such as self-administered surveys. For example, in a CV study of biodiversity conservation in the Philippines, Subade (2005) also finds that the percentage of yes responses at each bid level was higher among respondents subject to face-to-face interviews than those who were given self-administered questionnaires. In turn, the greater frequency of yes responses lead to higher estimates of mean WTP. Grandjean et al. (2009) and Maguire (2009) both find that estimates of mean WTP for improved environmental quality derived from phone surveys are significantly higher than those derived from internet panel and mail-based self-administered surveys.

Time-to-think treatments not only allow the respondent to carefully consider the questions being asked, but also reduce yea-saying behavior and social desirability bias, in which, according to Krosnick (1999), the presence of an interviewer may lead respondents to "distort their answers in surveys in order to present themselves as having more socially desirable or respectable characteristics". The results of the study suggest that the use of a secret ballot has a similar effect as time-to-think treatments in reducing yea-saying bias.

In both cases the percentage of yes responses declined as bid levels were increased. Among those who were offered the lowest bid level (PHP 50), 74% of respondents from Group A and 75% from Group B were willing to support the program at the offered price. On the other hand, among those who were offered the highest bid level (PHP 750), only 12% of respondents from Group A and 6% from Group B responded positively. The demand behavior of respondents towards the offered environmental good is therefore consistent with microeconomic theory, i.e. for a normal good, as the price increases, the proportion of those who are willing to pay decreases.

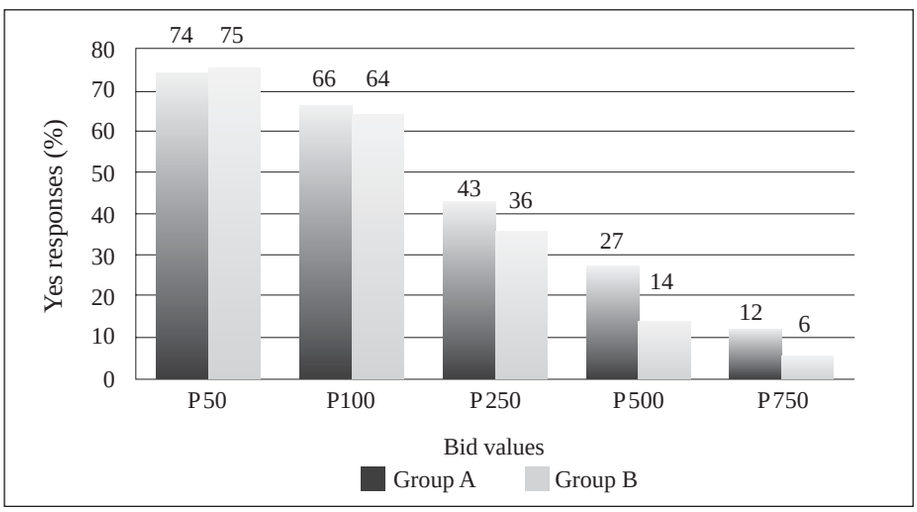

Figure 1: Distribution of yes responses compared between groups

Because each yes response was followed by a certainty question, it is possible to examine the interactions among WTP elicitation methods and certainty calibration. Figure 2 presents the distribution of yes responses compared between groups with and without certainty calibration. As discussed earlier, in the certainty-adjustment strategy employed in this study, only positive responses that were given a rating greater than or equal to 7 in a 10-point certainty scale were counted as yes responses.

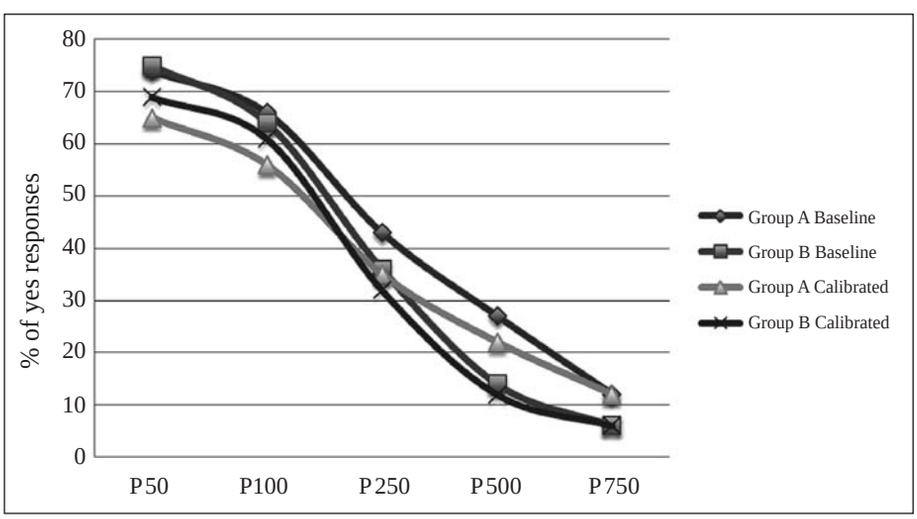

Figure 2: Distributions of yes responses with and without certainty calibration

The analysis yielded some interesting results. Certainty calibration seems to have a greater effect on lower bid values. For example in Group A, 74% of respondents who were assigned the lowest bid value (P 50) responded positively to the WTP question but this was reduced to 65% after certainty adjustment. In contrast, certainty adjustment had no effect on the percentage of yes responses at the highest bid level (P 750) for Group A. Similar results were seen in Group B, where certainty calibration reduced the percentage of yes responses by six percentage points (75% to 69%) at the lowest bid level but had no effect at the highest bid value. In other words, those who were assigned high bid values were surer about their answers than those who were assigned lower bid values.

These results suggest that respondents may be responding yes "too easily" at the lower levels, perhaps giving the decision less thought because the bid values are relatively small. In contrast, the higher bid values were too "significant" for them to take lightly and therefore made them think through their responses more thoroughly. As such, when asked how sure they were about their answers more of the respondents who were offered low bids were unsure about their answers compared to those who were offered higher bids.

Table 9 shows the distribution of certainty levels among yes responses. Half of yes-respondents in Group A and 67% of yes-respondents in Group B who were offered the highest bid value were "definitely sure" (=10) about their answers while only 40% of yes-respondents in Group A and 61% of yes-respondents in Group B who were offered the lowest bid value were "definitely sure".

Another interesting result is that the levels of certainty among yes-respondents across all bid levels are higher in Group B (Table 9). Only 8% of all yes-respondents in Group B rated their level of certainty below 7, compared to 14% in Group A. This finding suggests that if yea-saying is indeed linked to uncertainty (Champ et al., 1997) then the use of secret ballots may yield surer and thus more "truthful" responses.

Table 9: Distribution of certainty levels among yes responses

Certainty	**All**	**P 50**	**P 100**	**P 250**	**P 500**	**P 750**
Group A						
<7	32 (14%)	9 (12%)	10 (15%)	8 (19%)	5 (19%)	0 (0%)
=7 to 9	102 (46%)	33 (45%)	35 (53%)	17 (40%)	11 (41%)	6 (50%)
=10	88 (40%)	32 (43%)	21 (32%)	18 (42%)	11 (41%)	6 (50%)
Group B						
<7	16 (8%)	6 (8%)	3 (5%)	4 (11%)	2 (14%)	0 (0%)
=7 to 9	60 (31%)	17 (23%)	20 (31%)	16 (44%)	6 (43%)	2 (33%)
=10	119 (61%)	52 (69%)	41 (64%)	16 (44%)	6 (43%)	4 (67%)

Respondents from Group A were asked for the reasons why they voted in favor of the proposed program (Table 10). Respondents from Group B could not be asked because voting was conducted via the secret ballot technique. All Group A respondents (100%) who voted "yes" said that they wanted less air pollution in Metro Manila and that they wanted to protect their family from air pollution-related diseases. Ninety-four percent (94%) of respondents said that they supported the program and believed in its promised improvements to air quality. However, only 71% said that they had faith in the government's ability to implement the program.

Table 10: Reasons for answering "Yes" to the WTP question

Statement	Group A
I want the air in Metro Manila to be cleaner and less polluted.	100.00%
I want to protect my family from air pollution-related illnesses.	100.00%
I want future generations to enjoy clean air and a healthy environment.	96.62%
I support the electric jeepney program discussed above and I believe in the promised improvement in air quality.	93.72%
I have faith in the government's ability to implement the program.	71.50%

Table 11 summarizes the reasons cited by Group A respondents for voting against the proposed program. Again, Group B respondents could not be asked for their reasons given the nature of the secret ballot technique used. Most of those who voted "no" cited financial constraints (88%) as their reason for not voting in favor of the proposed program. Meanwhile, 11% of those who voted "no" said that the government should pay for the full cost of replacing the current diesel fleet, without passing the cost to households. Many of these particular respondents commented that they expect the government to use tax money to shoulder the full cost of the program since it was the government's responsibility to protect the environment. Some participants in the FGDs had a similar opinion. According to them, it was unacceptable for the government to pass on its "responsibilities" to households. On the other hand, 8% of no-respondents said that jeepney-owners should pay for the full cost of replacement instead. Five percent (5%) did not have faith in the government's ability to implement the program.

Table 11: Reasons for answering “No” to the WTP question

Statement	Group A
I cannot afford to pay any additional amount on top of our monthly electricity bill.	88.46%
I think that the monthly electricity bill is already too high.	9.79%
I think the government should finance the full cost of replacing the current jeepney fleet, without passing the cost to households.	11.19%
I think that jeepney owners/operators should pay for the cost of replacing their own fleet, without passing these costs to households.	7.69%
I do not have faith in the government’s ability to implement the program.	5.24%
I do not care about air pollution.	0.35%
I do not believe that paying the surcharge will actually result in better air quality in Metro Manila.	3.85%
I do not fully understand the program.	1.40%
I do not fully understand the questionnaire.	0.35%

4.5 Willingness-to-Pay for Cleaner Public Transport

Mean WTP was estimated using the analytical techniques discussed in Section 3.1. Both parametric and non-parametric (Turnbull) estimates were obtained. Table 12 shows the WTP of Metro Manila households per month for the proposed buy-back program, comparing Group A (conventional method) and Group B (secret ballot method).

Table 12: Parametric and non-parametric estimates of willingness to pay (WTP)

	Group A (conventional)	Group B (secret ballot)	Difference in Means
Parametric Estimates of Mean WTP (in PHP)			
All, unadjusted	259.75	205.04	54.71***
Certainty-calibrated (>/=7)	180.02	173.10	6.93
Difference in means	79.73***	31.94***	
Non-parametric Turnbull Estimates			
All, unadjusted	232.00	173.50	
Certainty-calibrated (>/=7)	219.00	155.50	

*** – significant at 1%.

Mean WTP is estimated at PHP 259.75 (USD 5.77) per month for 60 months for Group A (conventional method) and PHP 205.04 (USD 4.56) per month for Group B (secret ballot method). These values amount to 1.68% and 1.43% respectively of average household income. The difference between means is equal to PHP 54.71 (USD 1.22), which is statistically different from zero at the 99% confidence level. These results show that WTP is significantly lower for respondents who were asked to vote using the secret ballot procedure than for those who were asked to vote using the conventional face-to-face interview method. Therefore, the method of obtaining WTP responses does appear to have an impact on WTP estimates. In particular, there appears to be a yea-saying bias associated with face-to-face elicitation of willingness to pay.

However, certainty calibration seems to have the effect of reducing this bias. By only counting responses as a "yes" if given a certainty self-rating by respondents of 7 and above (Whitehead and Cherry, 2004), the percentages of yes-responses was reduced from 44% to 38% for Group A and from 39% to 36% for Group B. Mean WTP after certainty calibration (>/=7) is estimated at PHP 180.02 (USD 4.00) for Group A and PHP 173.10 (USD 3.85) for Group B. The difference between means is only PHP 6.93 (USD 0.15), which is not statistically different from zero at any level of confidence. On the other hand, mean WTP estimates after calibration for both groups are statistically different from mean WTP without calibration. Removing protest bids from Group A results in a WTP estimate of PHP 260.16 (USD 5.78), which is not statistically different from the WTP estimate for Group A without calibration. Turnbull estimates provide a conservative point of reference to the parametric mean WTP estimates.

4.6 Determinants of WTP

Factors that influence the decision to vote in favor of the proposed program were determined using the logistic regression model discussed in Section 3.1. As shown in Table 13, bid levels, income, education, and whether or not the respondent regularly uses public jeepneys were found to have significant effects on the WTP decision of household respondents.

Table 13: Determinants of WTP

	Group A (conventional)	**Group B (secret ballot)**	**Pooled Data**
Bid	-0.005248***	-0.007240***	-0.006062***
Income	0.000055***	0.000065***	0.000058***
Education	0.140578***	0.181494***	0.162421***
PUJ use (yes = 1; no = 0)	0.303041	0.752341***	0.402524**
Secret ballot	--	--	-0.355231**
Constant	1.277455***	-2.075914***	-1.442148***
LR chi2(4)	182.70	246.01	422.05
Prob>chi2	0.0000	0.0000	0.0000
Psuedo R2	0.2667	0.3679	0.3106

** – significant at 5%; *** – significant at 1%

Bid level, income and education are statistically significant at the 99% confidence level for each group taken individually and when data between groups are pooled together. As expected, bid levels are inversely related to the probability of a yes-response to the WTP question. The higher the cost of the program to the household, the less likely is it that the household would vote in favor of the program. Also as expected, income is positively related to the probability of a yes-response. Higher income households are more likely to vote in favor of the program given a particular bid price. Education, measured by number of years of schooling, also appears to be positively related to the probability of a yes-response.

On the other hand, results are inconclusive regarding the impact of respondents' regular use of public jeepneys (PUJ use) on the probability of a positive response to the WTP question. PUJ use is not statistically significant based on the regression of data from Group A, but is significant based on Group B at the 99% confidence level. When the regression is run on pooled data, PUJ use is significant at 95% confidence. In all cases, jeepney use appears to be positively related to the probability of a yes-response. As expected, a respondent who rides public jeepneys on a regular basis is more likely to respond positively to the WTP question in support of the proposed buy-back program.

The use of the secret ballot technique for eliciting responses to the WTP question appears to have a significant (95% confidence) negative influence on the probability of a yes-response. Asking respondents to cast their votes on the referendum using a secret ballot decreases the probability of them voting in favor of the program.

4.7 Benefit Aggregation, Cost-Benefit Analysis and Financial Viability

In this section, economic costs and benefits are compared to determine if replacing the entire fleet of diesel-run public utility jeepneys (PUJs) with zero-emission electric vehicles improves social welfare among Metro Manila residents (Table 14). A basic financial analysis is also performed to gauge the financial viability of the proposed buy-back program (Table 15). Note that in the following analysis, the more conservative and probably more accurate estimates from Group B (secret ballot) are used. The use of secret ballots is believed to reduce yea-saying behavior and social desirability bias.

From a social welfare perspective, the total benefit of replacing the diesel fleet is not limited to the benefits of clean air as captured by household WTP. It would also be wrong to simply compare this with the cost of the proposed buy-back program. Two groups are primarily involved – households and PUJ operators. Total benefits must therefore include both clean air benefits to households as well as the net benefit to PUJ operators.

Public utility jeepney (PUJ) operators are expected to benefit from savings in operating costs because the electric vehicles are cheaper to run than the existing fleet at current diesel prices (see Appendix 2). At an average of 40,000 kilometers serviced per year, jeepney operators can expect to save about PHP64,800 (USD 1,440) each year on operation and maintenance costs. However, the buy-back program will require operators to retire their diesel fleet prematurely. This amounts to a capital loss of approximately PHP 250,000 (USD 5,555), which is equal to the average market price of a used jeepney,

Note that the cost-benefit analysis has not included the costs of increased electric power generation that the shift to electric vehicles entails. Nonetheless, since all power sources are situated outside Metro Manila, the environmental impacts of increased power consumption/generation on Metro Manila residents may be minimal.

The estimated benefit (aggregate WTP) for Metro Manila households is PHP 5.43 billion (USD 120 million) per year. This amount is considerable and reflects the great importance that Metro Manila residents attach to the benefits of clean air from cleaner public transportation. On the other hand, PUJ operators are rendered worse off by the program by a total of PHP 5 billion (USD 110 million) as each operator stands to incur a net cost of more than PHP 150,000 per year in spite of the expected savings on operation and maintenance costs. However, it must be noted that these high figures are driven primarily by having to annualize the cost of prematurely retiring the diesel fleet and the cost of shouldering the remaining balance of the full price of the new vehicle over a relatively short five-year period. For simplicity, the remaining working life of the current fleet was assumed to be five years to match it with the five-year coverage of the buy-back program. However, many of the existing diesel jeepneys may in fact be operable for twice as long. Similarly, the remaining balance of the full cost of the new vehicle was also annualized over a five-year period. Thus, the working life of the new vehicle was set at five years, instead of the manufacturer claim of 10 to 12 years. Extending these accounting periods would have considerably decreased the annualized cost to PUJ operators. A thorough sensitivity analysis is recommended for further research.

Although PUJ operators incur a net loss as a result of the proposed program, the aggregate benefit to Metro Manila households is more than enough to offset this loss and yield positive net benefits of PHP 376 million (USD 8.3 million). The program yields a benefit-cost ratio of 1.07. The analysis therefore shows that replacement of the diesel fleet with zero-emission electric vehicles can improve social welfare.

However, the proceeding financial analysis shows that in spite of their substantial willingness to pay for the benefits of clean air, Metro Manila households will not be able to cover the full cost of the buy-back program on their own. The results suggest that government support in the form of counterpart funding and tax exemptions may be needed to cover the shortfall. Table 15 presents the relevant financial data.

It is assumed in the financial analysis that an optimal surcharge is collected from each household. This optimum generates the maximum collection revenue based on the percentage of yes-respondents per bid value from the household survey. Figure 3 plots total collections per bid value given the corresponding percentage of yes responses in Group B.

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Table 15: Financial analysis

	Group B
Total number of households (2010)	2,615,437
Optimum monthly electricity surcharge in PHP	250
Percentage of households willing to pay at optimum	32%
Total number of paying households	836,940
Total monthly collections in PHP	209,234,960
Total yearly collections	2,510,819,520
Total cost of five-year program in PHP	17,460,000,000
Cost of jeepney buy-back program per year	3,492,000,000
Net revenue	-981,180,480

Survey results show that a surcharge of PHP 250 per month is optimal. Thirty-two percent of households agreed to pay this amount. This would yield revenues of PHP 2.5 billion (USD 55.5 million) per year for five years. Annualizing the total cost of PHP 17.5 billion (USD 388.9 million) for the buy-back program to cover all 58,200 jeepneys, PHP 3.5 billion (USD 77.7 million) would be needed each year. This means that total collections would be about PHP 981 million (USD 21.8 million) short of breakeven.

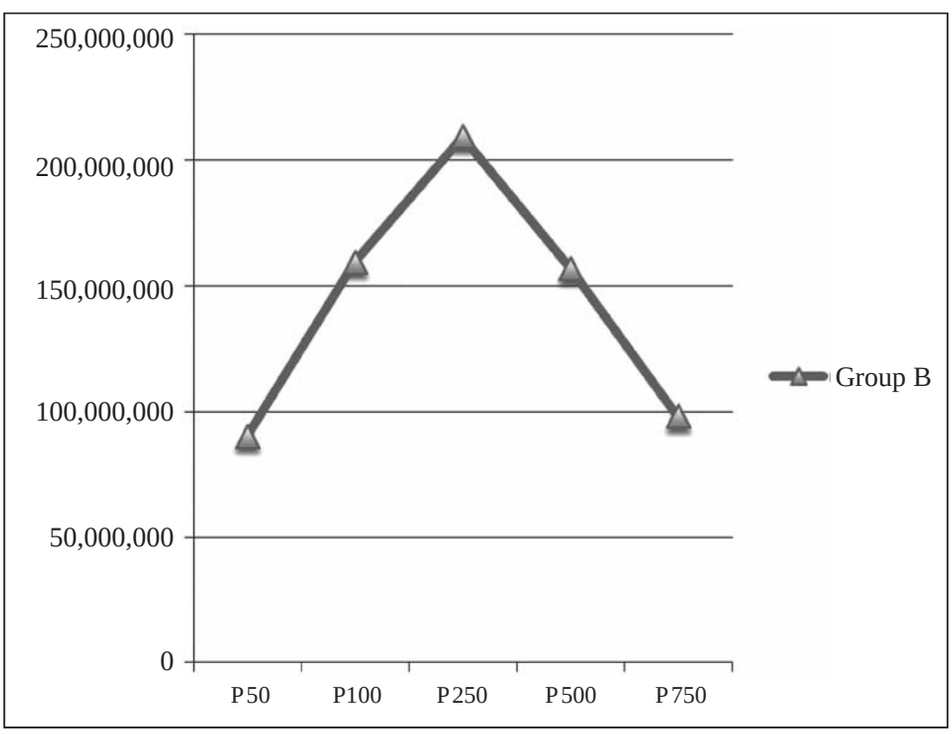

Figure 3: Total collections per bid level

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 On Willingness to Pay for Cleaner Public Transport

The study shows that Metro Manila households have a positive and significant willingness to pay for the benefits of cleaner public transport amounting PHP 173.10 (USD 3.85) per month. Income and education were found to be strong determinants of willingness to pay. Practically all respondents were knowledgeable about the harmful effects of vehicle-related air pollution and recognized that air pollution is a major problem in Metro Manila, ranking it as their second most important environmental concern. A simple cost-benefit analysis based on the estimated benefits (WTP) shows that the jeepney buy-back program could improve social welfare in Metro Manila, yielding net benefits of PHP 5.43 billion (USD 120 million) per year. However, the proposed program may not be financially viable without external support. Nonetheless, the WTP estimates obtained are substantial enough to encourage government and private enterprises to invest in the program or other similar projects aimed at providing cleaner public transport and reducing air pollution in Metro Manila, given that households appear to be willing to share in the cost of such programs.

5.2 On the Use of Secret Ballots

The study also shows how the chosen method of eliciting responses to the WTP question influences WTP estimation. Results show that respondents who are asked directly for their vote in the referendum through a conventional face-to-face interview are more likely to respond positively to the WTP question than those who are asked to cast their votes using a secret ballot. Not surprisingly, estimated WTP obtained from Group A (conventional method) is significantly higher than the WTP estimate from Group B (secret ballot method).

The literature (Turnbull, 1944; Krosnick et al., 2002) recommends the use of secret ballots particularly when either controversial or “high social prestige” issues are in question. This study shows how research on a topic which is neither particularly controversial nor one that puts social prestige at stake can nonetheless benefit from the use of secret ballots in eliciting responses to the WTP question as it provides a more conservative estimate of willingness to pay.

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APPENDICES

Appendix 1: English version of questionnaire (conventional method)

Thank you for agreeing to participate!

In this survey we ask a number of questions about your use of public transport and then discuss the current transport system and the levels of air pollution in Metro Manila. We then present a proposed program for cleaner public transport that will reduce air pollution in the metropolis. As you proceed, please take time to carefully read and understand each discussion before answering the questions that follow. There are no right or wrong answers to these questions. Information gathered from this survey may help government agencies assess public attitudes towards air pollution and the adoption of cleaner public transport systems.

1	Name (Optional):		
2	Address (Optional):		
3	Telephone No. (Optional):		
4	Gender: ☐ Male ☐ Female	5	Age:

Section A1: Background Information

1. Do you regularly use public transport?
   ☐ Yes ☐ No

2. What mode/s of public transport do you usually take? Please check all that apply.
   ☐ Bus ☐ LRT/MRT
   ☐ Jeepney ☐ Tricycle
   ☐ Taxi ☐ FX/Shuttle
   ☐ Ferry ☐ Others. Please specify: _____

3. How often do you take public transport?
   ☐ Daily (5 to 7 times a week)
   ☐ Less than five times a week
   ☐ A few times a month
   ☐ Never

4. What time do you usually take public transportation? Please check all that apply.
   ☐ Early morning (before 7:30 a.m.)
   ☐ Rush hours (7:30 a.m. – 10:00 a.m. or 3:00 p.m. – 7:30 p.m.)
   ☐ Around noon (10:01 a.m. – 2:59 p.m.)
   ☐ Late evening (after 7:30 p.m.)

5. The last time that you took public transportation, where did you go?
   - ☐ Airport/Pier
   - ☐ Home
   - ☐ School/Office
   - ☐ Places for leisure, recreation or worship (malls, parks, churches, etc.)
   - ☐ Others. Please specify: _____

6. What are your reasons for taking public transport? Please check all that apply.
   - ☐ a. It is the only means of transportation available; I do not own a vehicle.
   - ☐ b. It is convenient; I don't have to worry about driving or parking.
   - ☐ c. It is cheaper to take public transport than to use my own vehicle.
   - ☐ d. Others. Please specify: _____

Section A2: Use of Public Utility Jeepneys

1. Do you regularly ride public jeepneys?
   ☐ Yes ☐ No

2. On a typical day, how many jeepney rides do you take? _____ /day
   (Note: You may give a range, e.g. 3 to 4 times a day)

3. What are your reasons for taking jeepneys instead of other modes of public transport, such as buses or taxis? Please check all that apply.
   - ☐ a. It is the only form of public transportation available on the routes I take.
   - ☐ b. It is convenient since I can get on or off at any point without having to use designated stops or transit stations.
   - ☐ c. It is cheaper than other modes of public transport (e.g. taxi, bus, MRT)
   - ☐ d. Others. Please Specify: _____

Section B: Awareness and Attitudinal Questions

1. What do you think are the THREE (3) MOST SERIOUS environmental problems in Metro Manila today?

	Problems	**Rank (choose which is 1, 2 & 3)**
a.	Garbage	
b.	Air pollution	
c.	Noise	
d.	Pollution of rivers and Manila Bay	
e.	Traffic congestion	
f.	Groundwater depletion	
g.	Others:	

2. What are your THREE BIGGEST CONCERNS about the current public transport system in Metro Manila?

Concerns		Rank (with 1 being the highest, choose which is 1, 2 & 3)
a.	High cost of transportation	
b.	Limited number of buses, jeepneys and taxis	
c.	Air pollution, black fumes (usok)	
d.	Long queues (pila) and waiting time	
e.	Traffic; long travel time	
f.	Noise pollution from loud exhausts, engine-revving and excessive blowing of horns	
g.	Safety, security of personal belongings	
h.	Others:	

3. Please indicate which of these statements you think are TRUE and which you think are FALSE. Please mark the appropriate column with an "X".

Statements		True	False
a.	Air pollution increases the risk of cardiovascular and respiratory diseases such as bronchitis and asthma attacks.		
b.	Vehicle exhaust emissions are the biggest source of air pollution in Metro Manila.		
c.	Much of the pollution from motor vehicles comes from buses and jeepneys that run on diesel fuel.		
d.	The Clean Air Act mandates government authority to impose air quality and emissions standards.		
e.	The Environment Management Bureau (EMB) under the DENR is tasked to develop a comprehensive program to achieve and maintain air quality standards.		

4. How much do you agree or disagree with the following statements regarding traffic congestion and air pollution in Metro Manila?

	Statements	Strongly Agree	Agree	Disagree	Strongly Disagree
a.	Metro Manila roads are too congested; traffic is a problem.				
b.	The air quality along Metro Manila roads is poor.				
c.	Smoke-belching vehicles should be reprimanded and penalized.				
d.	Metro Manila roads/highways are too noisy.				
e.	Pollution from the exhausts of motor vehicles is harmful to people's health.				
f.	The major sources of vehicle-related air pollution in Metro Manila are public utility buses, jeepneys, and tricycles.				

5. How would you rate the level of AIR QUALITY in Metro Manila?

Very Good	Good	Tolerable	Poor	Very Poor

6. Do you think that AIR POLLUTION is a problem in Metro Manila?

☐ Yes ☐ No

7. Do you believe that the government is doing enough to improve air quality in Metro Manila?

☐ Yes ☐ No

8. How would you rate the importance of reducing air pollution in Metro Manila?

Very Important	Important	Not very Important	Not Important at all

If you selected "very important" or "important" please proceed to question #9.
If you selected "not very important" or "not important at all" please proceed to #10.

9. I think that reducing air pollution is important because… (Check all that apply)

☐ Pollution is harmful to nature and the environment.
☐ Fumes and smog are visually unappealing to me.
☐ Air pollution is hazardous to my health.
☐ Others, please specify _____

10. I think reducing air pollution is NOT important because… (Check all that apply)
    - ☐ It does not directly affect me.
    - ☐ I believe that pollution is simply the price we pay for progress.
    - ☐ The government has other more important problems to deal with.
    - ☐ Others, please specify _____

11. Among vehicular sources of air pollution, which do you think are the TOP THREE CONTRIBUTORS?

Sources	**Rank (with 1 being the highest, choose which is 1, 2 & 3)**
a. Private cars	
b. Taxis	
c. Public buses	
d. Public jeepneys	
e. Tricycles and motorcycles	
f. Trucks and delivery vans	
g. Others:	

Section C1: Air pollution and the Current Public Transport System

According to the World Health Organization, **Metro Manila is the fourth most polluted** urban region in the world. A large proportion of the population is exposed to particulate matter, sulfur dioxide, total oxidants, carbon monoxide, and lead at levels above international health and safety guidelines.

The EMB reports that mobile sources such as **motor vehicles** contribute between **70% and 90% of air pollution** in Metro Manila. The most important mobile source is **diesel-fueled vehicles**. A 2002 emissions inventory of Metro Manila reported that close to **50% of particulate matter emissions comes from jeepneys.**

Both users and non-users of public transport are affected by the pollution generated by jeepneys and buses. Some studies have shown that there is **no significant difference between pollution levels inside and outside homes**. This means that people on the streets (drivers, commuters, and pedestrians) and people at home are generally exposed to the same level of pollutants. Children and the elderly are particularly susceptible to air pollution-related ailments such as asthma attacks, acute and chronic bronchitis, cardiovascular and respiratory diseases, and in some cases even death.

Section C2: Proposed Program for Cleaner Public Transport

The purpose of this study is to determine how much households like yours would be willing to pay for the improvement in air quality that would result from a proposed program to be discussed with you shortly. Studies similar to this one have been conducted to estimate people's willingness to pay for different kinds of improvements on environmental goods. In such studies, the respondents are presented hypothetical situations and hypothetical payments as will be presented to you now.

In 2007, two electric-powered jeepneys were introduced in Makati City. The jeepneys are powered by five-horsepower electric motors with batteries that allow the vehicles to run distances of 120 to 140 kilometers at around 40 kilometers per hour. The batteries are charged for eight hours on ordinary 220-volt power outlets. The "e-jeepney" can seat 10 to 12 passengers. Since the new jeepney uses an electric motor rather than a combustion engine, it **runs very quietly** and **produces no emissions** from its exhaust.

The cost of replacing the current fleet of diesel-fueled jeepneys with their electric-powered counterparts is the biggest challenge to the adoption of the electric jeepney. **The new vehicle costs PHP 625,000**. All operators who participated in focused group discussions conducted for this study said they saw no need to replace their current units in spite of the rising cost of diesel fuel and the promised savings in operating costs of the electric jeepney. It is thus unlikely that operators would voluntarily replace their diesel-fueled

jeepneys with emission-free electronic jeepneys. Also, since jeepney operators tend to be small, family-run enterprises with limited resources, it may be particularly difficult for them to afford the full cost of replacement.

To address this problem, a five-year **diesel jeepney buy-back program** is proposed. This program is aimed at enabling public utility jeepney (PUJ) operators to retire their diesel fleets by paying them a lump sum of **PHP 300,000** for their diesel jeepneys to be **retired, converted to scrap and replaced** with electric vehicles. Only those with existing franchises of good standing will be eligible to apply for the program and **each diesel vehicle entered into the buy-back program will have to be replaced with an electric jeepney.**

The Land Transportation Franchise and Regulatory Board (LTFRB) currently issues five-year renewable franchises to PUJ operators. Upon the adoption of this program, the LTFRB will no longer renew franchises for diesel-fueled jeepneys. Therefore, **within five years all PUJs in Metro Manila will have to be electric vehicles** for them to be allowed to continue servicing their routes.

The PHP 300,000 lump sum paid to jeepney owners/operators who avail themselves of the program will serve as a **conditional subsidy**. The remaining balance of the cost of the new vehicle will have to be shouldered by the jeepney owners/operators themselves. Financing schemes at competitive interest rates will be available through private banks and government financial institutions. Meanwhile, **no fare increase** intended to cover the cost of purchasing the new vehicles will be allowed by the LTRFB.

To extend the proposed buy-back program to all 58,200 diesel PUJs so that the entire fleet could be replaced would cost some **PHP 17.4 billion**. The full replacement of all diesel jeepneys with electric vehicles is expected to result in a **50% reduction in PM emissions**. This reduction is about the same difference between the levels of pollution in major roads during the **morning rush hours versus early afternoon off-peak hours. Everyone** in Metro Manila, both users and non-users of public transport alike, are expected to feel the benefits of this drop in air pollution.

Suppose that to finance the buy-back program, the government plans to adopt a scheme by which **your household must directly contribute to the program** by being made to pay an additional amount on top of your monthly electricity bill for **60 consecutive months or five years**. Funds collected through this surcharge will be pooled by the government and used exclusively to finance the program discussed above. A law will ensure that the funds collected will not be used for any other purpose, under any circumstance. An independent watchdog will monitor all cash flows.

1. WTP Card

Suppose that we were to have a referendum on this program. If more than half of the people vote 'YES', and the referendum is passed, the buy-back program will be implemented and households like yours will be made to pay an additional P XXX.XX on top of your monthly electric bill every month for 60 months or five years to fund the program. On the other hand, if more than half of the people vote 'NO', then the program will not be implemented and no additional surcharge will be collected. Consider your household's income and expenditure, and remember that having to pay this additional amount, if the referendum is passed, will leave you with less money for, for example, food, clothing, transportation, and savings. Suppose that we were to take a secret vote now. Would you vote for this program?

YES	**NO**

If the respondent answered YES, please proceed to question #2 below.
If the respondent answered NO, please jump to question #4.

2. On a scale of 1 to 10 where 1 is "not sure at all" and 10 is "definitely sure", how sure are you that you would vote in favor of this program in a real referendum?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Not sure at all Definitely sure

If the respondent marked 6 or lower in the preceding scale, please answer question #2a below before proceeding to question #3.
If the respondent marked 7 or higher in the scale, please jump to question #3.

2a. Please explain why you have some doubts or hesitation about your vote in the referendum.

_____

_____

_____

_____

_____

_____

3. Please indicate the reason/s why you voted in favor of the program discussed above. Kindly check all that apply:

- ☐ I want the air in Metro Manila to be cleaner and less polluted.
- ☐ I want to protect my family from air pollution-related diseases.
- ☐ I want future generations to enjoy clean air and a healthy environment.
- ☐ I support the electric jeepney program discussed above and I believe in the promised improvement in air quality.
- ☐ I have faith in the government's ability to implement the program.
- ☐ Others, please specify: _____

If the respondent voted YES to the referendum question, please jump to Section D.
If the respondent voted NO, please answer the next question before proceeding.

4. If you did not vote in favor of the program discussed above, please indentify your reason/s. Please check all that apply.

- ☐ I cannot afford to pay any additional amount on top of our monthly electricity bill.
- ☐ I think that the monthly electricity bill is already too high.
- ☐ I think the government should finance the full cost of replacing the current jeepney fleet, without passing the cost to households.
- ☐ I think that jeepney owners/operators should pay for the cost of replacing their own fleet, without passing the costs to households.
- ☐ I do not have faith in the government's ability to implement the program.
- ☐ I do not care about air pollution.
- ☐ I do not believe that paying the surcharge will actually result in better air quality in Metro Manila.
- ☐ I do not fully understand the program.
- ☐ I do not fully understand this questionnaire.
- ☐ Others, please specify: _____

Section D: Socio-Economic Information

1. Age: _____

2. Gender: ☐ Male ☐ Female

3. Civil Status: ☐ Single ☐ Married ☐ Widow/er

4. Highest Educational Attainment:
   - ☐ Elementary
   - ☐ High school
   - ☐ College
   - ☐ Master Degree
   - ☐ PhD/MD/DDM/DVM
   - ☐ Others, please specify: _____

5. Occupation
   - ☐ Unemployed
   - ☐ Self-employed (own business)
   - ☐ Government employee
   - ☐ Private sector employee
   - ☐ Retired

6. Number of people in your household (excluding household help): _____

7. Average monthly electricity (Meralco) bill: _____

8. Please indicate your average MONTHLY income. This information is vital to our study. Please rest assured that information gathered will be kept confidential.

	Less than PHP 5,000		PHP 50,001-PHP 60,000
	PHP 5,001-PHP 10,000		PHP 60,001-PHP 70,000
	PHP 10,001-PHP 20,000		PHP 70,001-PHP 80,000
	PHP 20,001-PHP 30,000		PHP 80,001-PHP 90,000
	PHP 30,001-PHP 40,000		PHP 90,001-PHP 100,000
	PHP 40,001-PHP 50,000		More than PHP 100,000

Appendix 2: Comparison of operating and maintenance costs of PUJs

	Electric Jeepney		**Diesel-Fuelled PUJ**	
Fully charged battery	8	hours	n/a	
PHP/kw-hr Meralco rate	PHP 10.00		n/a	
Power cost	PHP 80.00		n/a	
Kms driven before recharging	60	km	n/a	
Power cost/km	**PHP 1.33**	**/km**	n/a	
Battery life	500	cycles	n/a	
Battery cost/pc.	PHP 5,000.00		n/a	
Battery cost (12 pcs)	PHP 60,000.00		n/a	
Battery cost/cycle	PHP 120.00		n/a	
Km driven per day	60	km		
Battery cost/km	**PHP 2.00**	**/km**	n/a	
PUJ fuel mileage	n/a		8	km/l
Fuel cost/l	n/a		PHP 37.00	/l
Fuel consumption @ 60 km	n/a		7.5	l
Fuel cost	n/a		PHP 277.50	
Fuel cost/km	n/a		**PHP 4.63**	**/km**
Cost of oil/pc	n/a		PHP 165.00	
Cost of oil (6 pcs)	n/a		PHP 990.00	
Cost of oil filter	n/a		PHP 170.00	
Change oil cycle	n/a		3,600	km
Change oil cost/km	n/a		**HP 0.32**	**/km**
Total Cost/km	**PHP 3.33**		**PHP 4.95**	
Savings/km	**PHP 1.62**			

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