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# V. CONCLUSIONS AND RECOMMENDATIONS

The previous sections discussed the observable and potential driving forces that could stimulate demand and supply for tricycles in each city, and identified the issues related to the respective tricycle subsector. It is therefore imperative for the local governments of both Quezon City and Puerto Princesa to review and assess their existing capabilities in order to come up with prudent decisions in responding effectively on possible scenarios in the future of the subsector. To assist the city governments in developing its strategic plan for tricycle pollution reduction, a number of possible options are presented in a matrix (Appendix 3) providing a concise description of each strategy and the extent of its impacts. These strategies are classified into different approaches and specific to the manner of intervention—those directly targeted at the tricycle units (engines, fuels and lubricants) and those external but could affect the operations of the tricycles (traffic and transport management). The possible implications of each option were evaluated to provide greater understanding of the issue at hand and assist the stakeholders, especially the local government, in the selection of the most appropriate strategy and policy option to take.

After the evaluation of currently available resources and consultation with various stakeholders, and considering the institutional, technical, cultural, social and economic aspects in the two cities, the following strategies are recommended:

- (a) LGU-led maintenance program;

- (b) mandatory orientation of tricycle drivers;
- (c) tricycle volume reduction program;
- (d) restriction on new and renewal tricycle franchise application with engines more than 15 years; and
- (e) promotion of alternative transportation.

A set of activities that the two LGUs need to implement to supplement the strategies are also recommended (Table 9). The strategies are further classified into short term (those that can be implemented within a year), medium term (those that can be implemented between 2 to 3 years), and long term (those that can be implemented between 4-5 years).

While the strategies are recommended for the two LGUs, the actual implementation of some of the strategies could be different due to the different social and economic status in the two LGUs. These differences are discussed under each respective strategy.

## A. LGU-led Maintenance Program (Short Term)

One of the most effective abatement measures in air pollution is adequate vehicle maintenance. This scheme can be made in partnership with the local government unit and the motorcycle manufacturers in which the task is to teach the TODA on preventive and periodic maintenance. Preventive maintenance is regular cleaning of the engine and other related parts affecting performance. It can be performed by the driver weekly or

**Table 9: Strategies and Supplementary Activities for Reducing Tricycle Pollution**

Strategy	Supplementary Activities	Features
A. LGU-led Maintenance Program (Short Term)	<ol style="list-style-type: none"> <li>1. Enhance Implementation of City Ordinance on the Use of Silencers in Tricycles (Short Term)</li> <li>2. Require Frequent Emission Testing (Medium Term)</li> <li>3. Periodic Roadside Monitoring (Medium Term)</li> </ol>	<ul style="list-style-type: none"> <li>• Preventive maintenance could reduce air and noise pollution by at least 20%</li> <li>• Adequate training could translate to a savings of at least P500 for a complete maintenance</li> <li>• Capacity building among tricycle drivers could provide alternative livelihood</li> </ul>
B. Mandatory Orientation of Tricycle Drivers (Short Term)	<ol style="list-style-type: none"> <li>1. Ban on Street Parking (Short Term)</li> <li>2. Enhancement of Tricycle Database (Short Term)</li> <li>3. Regulation of Tricycle Load (Short to Medium Term)</li> <li>4. Road Assessment and Isolation/ Rerouting of Tricycles (Short to Medium Term)</li> </ol>	<ul style="list-style-type: none"> <li>• Leveling of traffic understanding could ease traffic situations</li> <li>• Adequate knowledge of traffic signs and rules could ensure public safety</li> <li>• Orientation could double-check the validity of drivers' licenses and facilitate consensus among traffic enforcers and drivers</li> </ul>
C. Tricycle Volume Reduction Program (Short Term)	<ol style="list-style-type: none"> <li>1. Elimination of Illegal / <i>Colorum</i> Tricycle Units (Short Term)</li> <li>2. Adoption of Tricycle Body Colors and Numbers for Identification (Short Term)</li> </ol>	<ul style="list-style-type: none"> <li>• Reduction in tricycle volume could ease traffic by as much as 14% in QC and 20% in PPC</li> <li>• Reduction in the number of tricycle operating in the cities per day could reduce air and noise pollution by at least 20%</li> <li>• Reduction in volume could also reduce competition, thus could increase drivers' income by as much as 50%<sup>37</sup></li> </ul>
D. Restriction on New and Renewal of Tricycle Franchise Application with Engines Beyond 15 years of Age (Short Term)	<ol style="list-style-type: none"> <li>1. Phase-in of More Efficient Engines (Short to Medium Term)</li> <li>2. Strict Monitoring of Lube Quality (Short Term)</li> </ol>	<ul style="list-style-type: none"> <li>• Engines beyond 15 years in operation contribute mainly to noise and HC emission</li> <li>• Franchise restriction could encourage tricycle drivers to venture on alternative livelihood</li> </ul>
E. Promotion of Alternative Transportation (Medium to Long Term)	<ol style="list-style-type: none"> <li>1. Market Study to Determine: <ul style="list-style-type: none"> <li>• Competition between different transport modes</li> <li>• Applicability in certain areas</li> <li>• Availability of infrastructure and support services</li> <li>• Passenger demand and willingness to pay</li> </ul> </li> </ol>	<ul style="list-style-type: none"> <li>• Alternative transport encourages the shift to less pollutive transport modes</li> <li>• Bigger (and therefore, more efficient) vehicles could yield higher income due to higher occupancy</li> </ul>

<sup>37</sup> An experiment was conducted in Puerto Princesa City in April 2004, where the number of tricycles operating in the city was reduced by 20% per day. The drivers reported increase in their income levels of between 30-50%, depending on their areas of operation.

monthly. Estimated maintenance cost for important parts are about P500, and may take 1 day (or 9 hours).

Periodic maintenance, on the other hand, is cleaning and replacing parts that have been exhausted of their effective service life. Cost will depend on the parts to be replaced. For both Quezon City and Puerto Princesa City, the unanimous replacement period among drivers for most parts is semiannually.

Tapping the local government as the lead in maintenance program can be effective means to abate emissions. Technical and administrative capability can be sourced through partnerships with private institutions like Motorcycle Development Program Participants Association (MDPPA). The main role of the LGUs is to assure that all tricycles plying the area are regularly maintained. The TODAs and LGUs can work hand-in-hand to enhance enforcement, in which the former is encouraged to self-monitor its members. Proof of training participation can be done via certification (sticker type), which will then serve as a control mechanism.

A customized vehicle will be required so that the maintenance program will be done mobile. This will enable the maintenance team to reach out to TODAs and tricycles serving remote areas. If an existing vehicle is available at the LGUs, customizing a vehicle may cost P100,000 (\$1,800) inclusive of tools, consumables and vehicle improvement. The amount could be partially raised with TODA contributions, considering that there are about 147 TODAs in Quezon City and 20 TODAs in Puerto Princesa City that will benefit from the program. Also, the contribution will steer up a sense of ownership and will increase the level of participation among them.

Maintenance training could be free except for parts that will be replaced. This could be an attraction for the TODAs since the trainers will come from the manufacturers. They will also be assured of good practices plus the training, which will enable the TODAs to maintain their own vehicles and save P500 per complete clean-up.

To sustain the program, the City governments could assist the TODAs in setting up their own mobile maintenance unit, which at most will require a motorcycle. Certificate of accreditation should be provide by the LGUs and MDPPA to ensure the quality of the trained personnel in handling such program at the TODA level.

Vocational education on automechanics or any related courses (like, engine repair and maintenance) can also be initiated by the City government, in cooperation with the Department of Labor and Employment— Technical Education and Skills Development Authority (DOLE-TESDA). According to TESDA, it would only take 15 full days to complete a vocational course composed of 30% theory and 70% actual or hands-on application. And since a continuous course could significantly affect the participating driver's daily income, it is suggested that different schemes be explored and agreed upon by the City government, Federation of Tricycle Operators and Drivers Association (FTODA) and TESDA.

It should be noted, however, that the program in itself will not achieve its optimal effect and therefore, the following activities are suggested as supplements:

### **1. Enhance Implementation of City Ordinance on the Use of Silencers in Tricycles (Short Term)**

As previously discussed, it is deduced that most of the tricycle silencers, although installed, are no longer functioning as the noise level measured at the tailpipe shows that almost all of the tricycles surveyed exceeded the standard set under European Commission for Europe (ECE) 41. Chances are the silencers are not properly installed due to the limited knowledge of the drivers. This usually happens during engine cleanup, wherein the silencer is detached in order to remove the carbon deposits in the unit. With the appropriate preventive maintenance training to be initiated by the LGUs,

dislocation and/or modifications of motorcycle silencers could be prohibited. This will then ensure that the silencers attached to the motorcycles are indeed functional.

Similarly, the LGUs should institutionalize the use of silencers among the drivers. Although the drivers signified in the survey that they use silencers, spot inspections conducted during the study proved otherwise.

In Quezon City, for instance, City Ordinance No. SP-1227 series of 2003, requires the silencer installation in all tricycles and thus, 83% of the driver-respondents indicated that they use silencers. However, given the average noise level measured in the area (78-85 dB) under running conditions, it is suspected that silencers may be malfunctioning. Moreover, it is recommended that the Ordinance be revisited and appropriate corrective actions be done. Flaws on this ordinance were identified, which include among others: (i) the law does not impose penalty, (ii) it mandates noise pollution emission testing but not as a requisite for registration, (iii) its enforcement is weak as the implementing unit (TRU) lacks the equipment to measure tricycle noise levels, (iv) it requires a noise standard of 90 dB for tricycles in residential areas, which is not even acceptable for heavy industrial areas which is only 80 dB, and (v) there is a need for the TRU and even for the LGU to strengthen capacities in order to ensure effective enforcement of this ordinance.

In Puerto Princesa City, there is an existing City Ordinance that mandates the use of silencer and violation from such will result in a penalty of P50. Tricycle drivers, however, admitted that they would rather pay the nominal penalty than the expensive repair. It is therefore suggested that the said Ordinance be updated for a more effective implementation.

## **2. Require Frequent Emission Testing (Medium Term)**

The current emission-test requirement is not sufficient to resolve air pollution from

mobile sources. In reality, it is just procedural on the part of the tricycle drivers because one-day compliance in a year does not guarantee compliance for the remaining 364 days. Arranged and nonappearance emission tests and vehicle registration is also rampant in the subsector for just a few extra charges. For the tricycle driver, this becomes more practical than going through all the procedures. This scenario makes the whole emission test requirement useless.

It is therefore recommended that at least semiannual emission tests be required among tricycles and motorcycles. In order to do this without creating a market for private emission testing centers (PETC) or passing additional cost burden to the drivers, it is recommended that the City government explore possible arrangements with PETCs initially. One alternative is to arrange for a reduced fee (say, P70 per test, in which semiannual tests will be more or less the same with the existing emission fee). This could be done through a memorandum of agreement (MOA) between the PETC and FTODA, attested by the LGUs.

## **3. Periodic Roadside Monitoring (Medium Term)**

Annual emission tests do not solve the problem on vehicular emissions because it is only a day of inspection. A periodic emissions monitoring program may offer better results. Roadside monitoring needs to be done at random in order to determine the actual emissions from tricycles.

For Quezon City, since the local government is burdened with acquiring its own gas analyzer, it is suggested that the Air Quality Monitoring Section of DENR be tapped for periodic roadside monitoring under a collaborative effort.

In the case of Puerto Princesa City, the government has its own gas analyzer, which could be used for periodic roadside monitoring. There is a need, however, to enhance the technical capacities of the LGU, specifically the City Environment and Natural Resources

Office (CENRO) in conducting the tricycle tailpipe emission monitoring. It is therefore suggested that coordination with the Department of Science and Technology (DOST) should be forged for capacity building for the authorized personnel in the LGU.

## **B. Mandatory Orientation of Tricycle Drivers (Short Term)**

Educating the target sector is one way of solving an issue. Mandatory orientation is leveling of expectations between the traffic enforcers and tricycle drivers by clarifying the City's traffic ordinances and policies, as well as admonishing roadworthiness among the drivers.

The Tricycle Regulatory Unit (TRU) may pass an ordinance requiring all tricycle drivers to undergo the orientation. Traffic enforcers should be tapped while experts can also be sourced from other firms or institutions. It is expected to achieve high level of service (LOS) on the road when the users are educated. It could even reduce accidents and risk.

After 100% orientation, a pilot run must be made to assess the traffic situation. Once implemented, there must be associated penalties on the violations. New applicants will be required to undergo the same process; this way double checking of driver's license can also be addressed.

Orientation alone may not resolve the traffic congestion problems. As such, the following activities are also proposed to supplement the program:

### **1. Ban on Street Parking (Short Term)**

Tricycles tend to park or make long stops along their route, which are the tertiary and secondary roads (in some areas). This behavior causes delays and at times accidents due to limited road space. Prohibiting the tricycle from this action will help alleviate the traffic flows where traffic delays can be lessened. Available tricycles parked on the street may

be convenient for some passengers but the risk associated with this is also a major concern. This can be lessened if there will be no obstruction along the roads.

For this purpose, it is suggested that on-street parking be banned through a city ordinance. The LGUs should provide enforcers who can rove around their areas of jurisdiction while a corresponding terminal must be made available for the tricycles.

As a complementary solution, a transportation hub can be established whenever possible. A transportation hub is basically a convergence terminal of the available modes of public transportation where transferability is made easy since commuters will not roam around the CBD in order to get a ride. Some transport hubs are poorly planned that they create more problems to the environment. The local authorities should carefully assess the available land resources in their area near the CBD. The ideal hub must have a good circulation system, shaded walkways, ample space for vehicle parking, free from street vendors and, lastly, with high-ceiling structure and enough ventilation.

### **2. Enhancement of Tricycle Database (Short Term)**

There is a great need to improve the tricycle data at the city government level. The registration data from the Land Transportation Office (LTO) for motorcycle and tricycle is in a single account and for the entire provinces of Metro Manila and Palawan. Similarly, the registration data are misleading because tricycles cannot be isolated. Monitoring of tricycles can also be erroneous because the motorcycles can be easily detached while the sidecar has no registration plate in most areas.

In the case of Quezon City, what has been done so far by TRU is to mandate the provision of a body number and the name of service area on the sidecar's front and rear body.

Other data that requires improvement are actual population, actual services areas, route specifications, registration validity of tricycles units especially in Quezon City where some tricycles are also serving the adjacent cities of Marikina and Caloocan, plans and programs for the sector, completeness of ordinances, review of pending resolutions and evaluation of TODAs. The LGUs should form a Study Team or tap specialized institutions to assess the data gaps at TRU's end (or its equivalent agency) and formulate a strategy to address other requirements. The LGUs should also set aside a budget to finance the data collection and maintenance.

### **3. Regulation of Tricycle Load (Short to Medium Term)**

Load regulation strategy is a control mechanism to limit the pressure on an engine originally designed for two people. Present tricycle market has no restrictions on load. In Quezon City for instance, notice that an ordinance in this connection has been passed (No.SP-358,S-94) 10 years ago but most of the drivers confirmed that they load as much as 5 to 10 passengers in a tricycle. It is therefore recommended that review and effective implementation of such ordinance be done.

In Puerto Princesa City, on the other hand, the agricultural and tourism activities in the area should be considered in determining the appropriate load in order to match the passengers' transport needs. Another factor is the road condition, in which most of the tertiary roads in the City are deteriorated. The combined effect of the load and road condition yields stress on the engine and tricycle parts. As such, it is suggested that the maximum tolerable number of load should be 2 passengers, or 1 passenger and a luggage that weighs almost equal to 1 average person (that is, 75 kg).

With tricycle load being regulated, it is expected that the service life of the chain and sprocket will be extended from 6 months to 8 months. The total reduction of load is around 54.5 kg. There is an expected P114 (\$2)

savings on maintenance plus a lesser risk of exposure to danger and better stability due to lesser load.

Penalty can be imposed to put pressure on the drivers to comply. It should be emphasized that overloading poses great risk both to the passengers and road users. Considering that the demand for tricycle services is inelastic, it is possible for the TODAs to impose higher fares to compensate the cost of reducing load.

### **4. Road Assessment and Isolation/ Rerouting of Tricycles (Short to Medium Term)**

Isolating and /or rerouting the tricycles from the other modes can be a promising traffic reduction program. High level of service (LOS) will be experienced on both main road and new route. It will also minimize the risk between the tricycles and the bigger modes.

Isolating and/or rerouting strategy is to separate small three-wheelers from bigger transport modes. Mixing both modes add more friction to the traffic. The idea is similar to the expressways where a service road is provided for slower vehicles with shorter travel while vehicles on the expressway move with high speed. In some areas where there is inadequate land resource, the immediate alternative will be traffic rerouting for the tricycles (short-term plan). The LGUs should pursue the rerouting as the initial step in improving traffic and road safety. This strategy will be more beneficial if complemented with a plan that will identify and acquire a road right-of-way (RROW) to cater to the residential environment, in which budget for acquisition will be required. This should be coordinated with the DPWH for proper execution.

For Puerto Princesa City, three TODAs plying along Rizal Avenue and around the poblacion will be affected with the rerouting scheme. About 11 TODAs taking the Malvar-National Highway route will also be affected. In general, all tricycles plying the Rizal Avenue may be diverted to the adjacent streets

without passing the main road. Although operation in the said avenue will be prohibited, tricycles may be allowed to pass through as they are redirected to their newly designated routes. It has been observed that Malvar Street absorbs 55% of the tricycle routes and most of these routes are directed outside the poblacion. Also, the long-haul trips to Sabang and El Nido also traverse this route, most of which are over-sized jeepneys and medium-sized buses with terminals located near the west end of Malvar St. On top of that, the temporary wet market and other major establishments are situated along this road. Although Malvar Street is a 4-lane, 2-way road that should be enough to accommodate the current travel demand, the absence of shoulder recess for boarding and alighting, coupled with a mix mode of small- to medium-sized public transport, makes the road chronically congested. Even with the relocation of the public market, it is expected that the congestion in this street will prevail due to the volume of vehicular flows.

Therefore, a daily inventory of the congested areas along Malvar Street should be made to pinpoint the major contributors. Also, an on-site route-specific study should be made to carefully pilot and gauge the total impact in redirecting tricycle routes away from this street. The LGU can also complement the rerouting scheme with terminal relocation, transfer of establishments, no-parking road policy, new by-pass roads, or one-way street conversion. Also, pedestrian controls like fenced sidewalks and designated pedestrian lanes are necessary since there are no specific crosswalks for the people; allowing them to cross the street anywhere causes slower vehicular traffic.

### **C. Tricycle Volume Reduction Program (Short Term)**

The tricycle volume reduction program (TVRP) must be used as an independent measure to reduce traffic as well as emission levels. This entails a one-day off among

tricycle drivers within the same TODA. Localizing this program at the barangay level will provide for more effective implementation since the TODA members themselves will monitor and apprehend any illegal tricycle operations.

With an estimated 14% reduction in traffic volume in Quezon City, there will be corresponding 17 additional trips for the drivers, translating to an increase in their income. Estimated reduction on HC will be 123,435,000 ppm per week and 2% CO reduction per unit. Given the proper arrangement with the TODAs and traffic management groups, a one-year window is enough to start its implementation.

In Puerto Princesa City, however, a 20% reduction in traffic volume is estimated. This could translate to 17 additional trips for the drivers, reduction on HC of about 123,435,000 ppm per week, reduction on CO of about 2% per unit.

This can be easily implemented in a year's time given the proper arrangement with the TODAs and traffic management groups. TVRP should not be mixed with future traffic reduction programs for bigger modes. It should be applied independently since tricycles operate differently. This strategy could be applied to all areas within the city regardless of urbanization level.

This could also be made mandatory through a city-wide ordinance from the LGUs and should cover even the outskirts of the city bordering the neighboring areas. There must also be enhancement of local capacities in undertaking monitoring and apprehension at the barangay level. Similarly, traffic enforcers at the barangay level should be intensified in this connection.

To ensure the success of the program, it is suggested that the following supplementary activities be conducted as well:

#### **1. Elimination of Illegal / *Colorum* Tricycle Units (Short Term)**

During the site inspections conducted by ADB, it has been observed that a number of tricycles are operating illegally. Most of the TODA representatives and barangay captains expressed serious concerns on tricycles that are operating illegally in various routes and utilizing public roads as terminals. The implementation of TVRP in the absence of control mechanisms on these illegal tricycles will defeat the traffic-reduction purpose and put the franchised tricycle drivers in a disadvantaged position.

However, illegal operators signified their interests in applying for franchise as they usually end up paying bribes to traffic personnel. Considering the volume of franchise applicants and the tedious process of applications due to the limited number allowed to operate in a particular route, there is very low probability for a new tricycle operator to get a franchise in a year or two. Total franchise application fee does not exceed P5,000 per unit. But the current system creates a market among tricycle drivers to trade the franchise among themselves for as much as P25,000. It is therefore suggested that TVRP be complemented with process simplification and policy modifications in tricycle franchise applications.

Similarly, the absence of identification codes encourages the proliferation of illegal units. In Quezon City, body color is used to identify the TODA as well as facilitate identification of illegal units. In Puerto Princesa City however, there is no existing ordinance on body color for the tricycle. The current system of using a sticker in the front end of the sidecar as identification is not as effective as body color since the former requires tedious vehicle inspection. The danger of implementing a TVRP without using body color is the possible operation of affected tricycles in other routes, thus causing further traffic congestion. The body color can be used to identify specific routes where tricycles should operate, and be subjected to their route's TVRP scheme.

To supplement the body color scheme, a body number and TODA name painted on the front and rear end would be practical to adopt. The two control mechanisms can help address the problem on illegal units. The current situation has loose control measures due to the absence of these. A body number can avoid sidecar switching and therefore, minimize illegal operations.

The body color used in Quezon City is placed on the front panel where it can be visible to the public. The number is six inches high; above it is the TODA name and underneath is the name of the city. A body number also provides additional control in case body colors are duplicated in another TODA. Body numbers could significantly contribute to the implementation of TVRP by providing highly visible identifications that could easily determine if such tricycle unit is allowed to operate on a particular day of the week, in such particular route.

#### **D. Restriction on New and Renewal Tricycle Franchise Application with Engines more than 15 Years (Short Term)**

Important consideration should be made in discouraging the use of engines that have been operational for a long time. Technically, tricycle performance is reduced as it ages and therefore, the use of old units should be prohibited.

Previous discussions show that tricycles beyond 15 years in operations are major sources of air and noise pollution. Therefore, initial target could be set at tricycles with age above 15 years. In doing so, it is recommended that any application, either new or renewal, for tricycle units with motorcycle engines beyond 15 years old be disallowed. Over time, the target prohibition should be gradually reduced to tricycles with age more than 10 years. This will encourage the use of new and therefore more efficient tricycle fleet in the cities while promoting more efficient transport modes at the same time.

To prevent resistance or public dispute from the affected tricycle drivers, it is recommended that this strategy be accompanied with a trade-in option or financial assistance for those who would like to buy new motorcycle units. Such arrangement can be explored with motorcycle manufacturers to determine whether this option is acceptable to them.

Buy-back, on the other hand, may not be advisable considering the procurement and disposal issues involved. First, an LGU buying old and inefficient vehicles (which can be classified as waste) may be questioned considering the current government procurement practices. Second, if such units will be bought and relocated in other areas, the problem of air and noise pollution is not reduced but shifted to another location. Third, considering that there is very short serviceable life remaining for such vehicles, LGUs will soon face disposal problems. Fourth, the purchase of these old and inefficient vehicles could drain the LGU's financial resources. A motorcycle unit of 15 years and above is estimated to cost about P10,000 (\$185) the most. Given 1,305 affected units in Quezon City and 256 units in Puerto Princesa City, the buy-back option could cost the LGUs about P13.05 million (\$233,450) and P2.56 million (\$45,800) respectively for the first year alone. Considering that there are vehicles that will be reaching the cut-off age in the succeeding years, it could result to a tremendous financial burden on the part of the LGUs.

Similarly, the following activities are suggested to supplement the program:

#### **1. Phase-in of More Efficient Engines (Short Term to Medium Term)**

As the franchise restriction program allows the entry of new vehicles, it is suggested that the use of more efficient engines and cleaner technologies be encouraged as well in the short to medium term. Emission tests conducted shows that 4-strokes have lower hydrocarbon emissions compared to 2-stroke engines at idle and

running conditions. Technically, it also has very low CO emission if maintained properly.

A 4-stroke motorcycle engine, however, is expected to cost an additional upfront cost of P1,000 (\$18) to P5,000 (\$92) upon procurement compared to a 2-stroke engine. Additional maintenance and labor cost amounting to P2,200 (\$40) is also expected per year since more parts have to be maintained upon conversion to a tricycle. However, since 4-stroke is fuel-efficient compared with 2-stroke, it is expected to reduce fuel consumption by 10-20% or an equivalence of P4,700 (\$86) per year. Lubricant consumption will also be eliminated, translating to lube savings of P5,400 (\$99) per year. Therefore, the additional maintenance and labor cost will be offset while the additional upfront cost for procurement is expected to recover within 6 months of operations.

On the other hand, extra precaution should be exercised as 4-strokes are known sources of nitrogen oxides. A number of tests are currently being conducted in other countries that include the application of catalytic converters in order to address these problems. However, in the absence of appropriate tests for Philippine application, it is recommended that adequate maintenance be encouraged among tricycle drivers. As such, this could also be tied up with the strategy initially proposed on preventive maintenance. Also, the use of 4-stroke engines should not be used as an exemption from the coverage of standards set under the Clean Air Act (CAA), as well as from periodic roadside monitoring program proposed previously.

#### **2. Strict Monitoring of Lube Quality (Short Term)**

During site inspections conducted by ADB, it was observed that informal gasoline and lubricant store or *takal* (repacked in small amounts) are rampant in several areas in both cities. The case is much severe in Puerto Princesa City where there are only three gasoline stations, which are all located in the CBD. Tricycles operating in distant areas have

no choice but to resort to takals. The drivers' mode of operation also makes takals attractive given that their income is realized in small amounts and only when services are rendered. In that way, they do not have to line up at a gasoline station to buy a liter of two of gasoline every now and then. However, since gasoline and lubes are repacked, the tricycle drivers may not be aware of the source from which they were acquired, as well as on possible adulteration or contamination of qualities.

In general, all lubricants look the same, regardless of brand and source. Therefore, it is difficult for a tricycle driver to determine if the lube being sold is refined, treated (used oil but undergo treatment) or untreated (used oil that undergo simple sedimentation process) once poured into smaller containers. Sometimes, the driver themselves pay little attention on the type of oil as they are more concerned about the cost. Refined lube usually costs P90 (\$1.65) per liter while treated lube costs around P65 (\$1.20) per liter. Used and untreated lube, commonly sourced from used transformer oils, costs only P20 (\$0.37) per liter. If the driver intends to minimize his operational costs, he would be tempted to buy the cheapest which is the used and untreated oil. Considering that in a 2-stroke, the fuel and oil are mixed in the combustion chamber. Thus, lower lube grade has lower combustion efficiency that results to higher CO and HC emissions.

To address this issue, it is recommended that the City government coordinate with the Department of Energy (DOE) in monitoring the quality of lubricants sold in the retail stores. Random testing can be done by DOE, since they have the personnel and equipment, but the local government should assist in identifying the locations of these stores as well as ensure the safety of the DOE personnel. Similarly, the local government should assist the DOE in promoting its proper disposal campaign of used oil at the gasoline stations, considering that used oil is classified as a hazardous waste under Republic Act 6969. It could also be beneficial to accredit or partner with some vendors to sell fuel and lubricant in

the remote areas after formal arrangements from the gas stations.

In Puerto Princesa City, the limited operations of gasoline stations due to market disincentives should be considered in making fuel and lube available in distant areas. One possibility is to establish a cooperative in each TODA, which will then administer the retail selling of fuel and lube among its member-drivers and operators. The cooperative can enter into partnership with oil companies or gasoline stations to guarantee product quality and promote environmental and health safety in product handling, storage, and waste disposal. The gas refilling stations to be managed by the cooperative can be housed in the tricycle terminals and repair service stations as suggested previously.

#### **E. Promotion of Alternative Transportation (Medium to Long Term)**

There is a need for a low-emission transport mode to replace the tricycle. Alternative transport, in any sense, is a mode that can both be practical and environment-friendly. There is no competition with tricycle in terms of practicality especially in areas where tricycles are the main mode of transport in collector roads. But medium-sized vehicles like multicabs can be an option. The multicab is a 4-stroke transport mode with higher occupancy and capacity that emits lesser pollutants. Fares can be made competitive due to higher occupancy. Tricycles generally charge higher fare across the metropolis, e.g., P6-P10 per person. There is potential fuel savings compared to tricycles, and is expected to yield higher income.

Prior to its implementation, a market study is needed to determine (i) the extent of possible competition with other modes, (ii) the appropriate area especially those with no tricycles yet, (iii) availability of support services like gas stations, repair shops, parts supply, and (iii) passenger demand.

For Quezon City, it would be best that the next pipelined urban and/or housing development project will mandate the prohibition of tricycles and pilot test the area without any intervention of three-wheelers in order to see the full potential of the program. Also, since LGU has access to the suppliers of multicabs, as they are being used as transport service of city government officials and offices, it may be possible to arrange procurement with flexible terms for small investors. At any rate the City government must coordinate directly with the manufacturers in order to significantly reduce the price and make it more commercially competitive. This program should not be limited to multicabs since there are other potential alternatives but only lacks marketing. In essence the criteria for an ideal alternative transport mode is (a) less pollutant or even zero-emission, (b) viable for feeder roads, (c) ample and accessible support services, (d) price competitive, and (e) sustainable.

For Puerto Princesa City, however, it is very crucial to identify areas of development and set a standard for transport modes other than tricycles. Such transport mode should take into consideration the nature and potentials of particular areas in which they will be applied. Examples of such areas are the proposed urban corridors of San Manuel, Sta. Monica, San Jose and San Pedro. Note that these areas are mostly fishing villages and

support services needed are mainly for transporting marine products. Thus, the load requirement and hauling conditions should also be met. Furthermore, since multicabs are already in place in Puerto Princesa City but usually cater to longer routes, it is advisable to identify areas, especially in remote communities and fishing villages, in which they can be utilized given fixed trip intervals. This will reduce dependence on tricycles and thus minimize pollution.

Promotion of HOVs is only one way to make the strategy effective, and complementary program should be aimed at the target market. Many policies become effective because the receiving ends are well informed. In this case, there should be a public information campaign on the benefits of high-occupancy vehicles especially if the local residents themselves will be directly affected. It is generally accepted that pollution-free environment is a major consideration for communities as well as land and housing development. The elimination of a heavier polluting transport mode can therefore be translated into better living environments and improved living standards. Note however, that the corresponding program for the promotion (and supply) of clean alternative transport is demand-driven. Thus, educating the passengers to utilize cleaner technologies is an effective means of promoting this strategy.