Project Number: 43207
August 2012

Republic of the Philippines: Market Transformation through Introduction of Energy-Efficient Electric Vehicles Project

Main Project Document

CURRENCY EQUIVALENTS
(as of 6 June 2012)

Currency unit	–	peso/s (P)
P1.00	=	$0.0230
$1.00	=	P43.53

ABBREVIATIONS

ADB	–	Asian Development Bank
CTF	–	Clean Technology Fund
DOE	–	Department of Energy
ICE	–	internal combustion engine
kg	–	kilogram (1,000 grams)
km	–	kilometer (1,000 meters)
kWh	–	kilowatt-hour (1,000 watt-hours)
LBP	–	Land Bank of the Philippines
LGU	–	local government unit
LIBOR	–	London interbank offered rate
MIT	–	Massachusetts Institute of Technology
PAM	–	project administration manual

NOTE

In this report, "$" refers to US dollars.

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CONTENTS

PROJECT AT A GLANCE

1. Project Name: Market Transformation through Introduction of Energy-Efficient Electric Tricycles
2. Project Number: 43207-013

3. Country: Philippines **4. Department/Division:** Southeast Asia Department/Energy Division

5. Sector Classification:

Sectors	Primary	Subsectors
Energy	√	Energy efficiency and conservation
Transport, and information and communication technology		Transport management and policies

6.Thematic Classification:

Themes	Primary	Subthemes
Economic growth	√	
Environmental sustainability		
Capacity development		

6a. Climate Change Impact:

Mitigation	High

6b. Gender Mainstreaming:

Effective gender mainstreaming (EGM)	
Gender equity theme (GEN)	
No gender elements (NGE)	
Some gender benefits (SGB)	√

7. Targeting Classification:

	Targeted Intervention		
General Intervention	Geographic dimensions of inclusive growth	Millennium development goals	Income poverty at household level
√			

8. Location Impact:

Rural	Medium
Urban	High
National	Low
Regional	

9. Project Risk Categorization: High

10. Safeguard Categorization:

Environment	**C**
Involuntary resettlement	**C**
Indigenous peoples	**C**

11. ADB Financing:

Sovereign/Nonsovereign	**Modality**	**Source**	**Amount** ($ million)
Sovereign	Project loan	Ordinary capital resources	300.0
Total			**300.0**

12. Cofinancing:

Financier	**Category**	**Amount** ($ million)	**Administration Type**
Clean Technology Fund	Official-Grant	5.0	Full
Clean Technology Fund	Official-Loan	100.0	Full
Total		**105.0**	

13. Counterpart Financing:

Source	**Amount** ($ million)
Government	99.0
Others	
Total	**99.0**

14. Aid Effectiveness: Not Applicable

I. THE PROPOSAL

1. This is a report on a proposed loan and a grant to Republic of the Philippines for the Market Transformation through Introduction of Energy Efficient Electric Vehicles Project.[1]

II. THE PROJECT

A. Rationale

2. Electric vehicles or e-vehicles represent a new technology with the promise to transform the way energy is used by today's internal combustion engine (ICE) vehicles. For net energy-importing countries such as the Philippines, e-vehicles can dramatically reduce the country's oil dependency and improve long-term energy security. They are efficient, generate no harmful air and noise pollution, and can be powered by indigenous renewable energy.

3. Countries around the world are introducing e-vehicles to reduce energy security concerns: for example, the Government of Israel has created generous policy incentives to support its commitment to 100% e-vehicles by 2020; the Government of the United States provides rebates of up to $7,500 per vehicle and has a target of 1 million electric cars by 2015. The International Energy Agency's Technology Roadmap[2] recently announced the proactive policies of the 17 countries—including the United Kingdom, Australia, Ireland, Japan, Singapore—that will support sales and deployment of 7 million e-vehicles by 2020.

4. Accounting for the total energy consumed from well to wheel,[3] e-vehicles can reduce energy consumption by up to 50% and greenhouse gas emissions by up to 60% compared with ICE vehicles because: (i) no electricity is used while stranded in traffic jams (except air conditioning); (ii) energy losses in electric motors are about 5%–15%, compared with 70%–80% losses in the engines of ICE vehicles; and (iii) transmission and distribution of electricity is more efficient and cost-effective than transporting liquid fuels to the end user.

5. The Philippines is in the forefront of developing a local e-vehicle industry—electric tricycles or e-trikes, e-jeepneys, and e-buses. Since 2009, e-vehicle enthusiasts have undertaken various small, isolated initiatives, and the Government of the Philippines plans to fast-track the process using e-trikes as a priority. In April 2011, the Asian Development Bank (ADB) introduced,[4] as a pilot, 20 locally made e-trikes powered by imported lithium-ion batteries in the City of Mandaluyong. Although technical results of the pilot were promising, difficulty in sourcing spare parts and shortage of local technical expertise clearly highlighted that large scale adoption would only be feasible with the establishment of a local e-trike industry to eliminate technology risk and broader adoption of electric vehicles. With these lessons from the pilot, the government plans to scale up the pilot program[5] and use an early-adopter opportunity to establish a sustainable local e-vehicle industry. This initiative has also attracted several reputable global battery and car manufacturers in the country, who consider the local market as

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[1] The design and monitoring framework is in Appendix 1.

[2] International Energy Agency. 2011. Technology Roadmap: Electric and plug-in hybrid electric vehicles. {City} (June, http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf).

[3] Energy consumed and greenhouse gases emitted from the time a vehicle's energy source leaves the well to the time it is consumed by the vehicle (http://web.mit.edu/evt/summary_wtw.pdf).

[4] Financed by ADB. 2007. *Technical Assistance for Efficiency Improvement and Connectivity Strengthening in Archipelagic Southeast Asia Project*. Manila (TA 6441-REG).

[5] Prepared by ADB. 2010. *Technical Assistance to the Republic of the Philippines for Mitigation of Climate Change through Increased Energy Efficiency and the Use of Clean Energy*. Manila (TA 7754-PHI).

the launching pad for exporting these $4,000–$5,000 e-trikes to neighboring countries in South Asia and Southeast Asia.

6. The government plans to transform the nascent e-trike industry into an industry with at least three large local e-vehicle manufacturers. Large reputable global electric car (and battery) manufacturers are focused on bringing in the early adopter's family car (Nissan Leaf, Chevy Volt, and Toyota Prius) with a price tag of about $45,000 for markets in Europe, the United States, and Australia. The Philippine vision is to transform the "base of the pyramid," the tricycles, through technology leapfrogging. The combination of lithium-ion battery technology and e-trikes designed professionally to international standards will establish higher safety, environmental, and efficiency principles. The proposed e-vehicle policy[6] also directly supports e-vehicle-related businesses and will provide tax exemption on imported e-vehicles for 9 years.

7. Use of lithium-ion batteries will also reduce the risk of reintroduction of lead to the transport sector. Excessive use of e-bikes and e-trikes with lead-acid batteries and improper disposal prompted authorities in the People's Republic of China to crack down on the industry.[7] The Philippines faces the risk that a large volume of imported, substandard tricycles with poor-quality lead-acid batteries will reintroduce lead to the environment. This may add to existing concerns on illegal smelting[8] of lead.[9]

8. For this transformation, the government has sought support from the Clean Technology Fund (CTF), which has resources amounting to more than $4 billion pledged by major donors such as Australia, France, Germany, Japan, Spain, Sweden, the United Kingdom, and the United States. In December 2009, the Trust Fund Committee for the CTF endorsed the Philippine Country Investment Plan,[10] which the government updated and submitted for approval in June 2012 to use CTF funds to lower the cost of transforming the energy use by tricycles.[11] The role of CTF fund is beyond concessional financing—use of CTF funds have allowed the Government to "Think Big" and commit to invest in 100,000 locally made electric vehicles by 2016. This is largest time bound commitment by any Asian country and is comparable to US Government's commitment to have 1 million e-vehicles by 2015, 2 million e-vehicles by 2020 (France), 1 million e-vehicles by 2020 (Germany), 350,000 e-vehicles by 2020 (Ireland), 100,000 e-vehicles annually from 2012 (Israel), 20% market share by e-vehicles (Japan) and 1.2 million e-vehicles by 2020 (UK).

9. In 2010, the Philippines spent about $10 billion[12] (a 39% increase from 2009) on oil import, or about $27 million a day, of which about 70% was for the transport sector. The average cost of import was about $80 per barrel and, on average, between 30 to 40 days worth of inventory was in the system—creating key concerns on energy security. Preliminary modeling shows that a 7% e-vehicle penetration by 2015 and 15% by 2030 can reduce fuel imports by

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[6] Senate Committee Report No. 44 on Senate Bill No. 285–Electric, Hybrid, and Other Alternative Fuel Vehicles Incentives Act of 2011 (accessible from the list of linked documents in Appendix 2).

[7] Recently, the government closed down 583 lead-acid battery manufacturing plants because of improper disposal of hazardous waste and poor technical standard (http://www.zhb.gov.cn/zhxx/hjyw/201108/t20110802_215645.htm).

[8] The Department of Environment and Natural Resources recently ordered a nationwide campaign against illegal smelting of lead-acid batteries (http://www.gov.ph/2011/09/01/denr-orders-crackdown-on-illegal-used-lead-acid-battery-recycling-plants-in-region-3/).

[9] Lead Acid: A Growing Environmental Problem (accessible from the list of linked documents in Appendix 2).

[10] Government of the Philippines. 2009. *Philippine Country Investment Plan.* Manila (December, http://www.dotc.gov.ph/Philippines%20CTF%20CIP%20Nov%209.pdf).

[11] A detailed discussion on emissions reduction is in Clean Development Mechanism Credits (accessible from the list of linked documents in Appendix 2).

[12] Department of Energy (available at: http://www.doe.gov.ph/DO/Report2010.htm).

approximately 6% in 2015, 13% in 2020, and more than 40% by 2030, with more reductions in greenhouse gas emissions and air pollution.

10. The National Framework Strategy on Climate Change, 2010–2022[13] recognizes a low-carbon path in the transport sector as an essential element and promotes models to improve the transport sector's efficiency, as part of its strategic priority. The project is consistent with the Fueling Sustainable Transport Program of the Department of Energy (DOE)[14] and the Alternative Fuel Vehicles Incentives Act of 2011. The promotion of new technology and energy-efficient transportation solutions is part of the core lending strategy of the assessment strategy and road map for the Philippine energy sector, and the program is in the country operations business plan, 2012–2014.[15]

B. Impact and Outcome

11. The impact of the project will be sustainable energy use by the transport sector, and the outcome will be the transformation of the tricycle industry through large-scale adoption of locally made energy-efficient e-trikes.

C. Outputs

12. The project has five outputs: (i) complete e-trike units delivered to local government units (LGUs) accompanied by a standard 3-year warranty; (ii) lithium-ion battery supply chain with associated support services established; (iii) solar charging stations pilot in selected areas; (iv) material recovery from ICE tricycles and used batteries; and (v) successful communication, social mobilization, and technology transfer.

13. **Output 1: E-trike units.** The project will deliver 100,000 complete e-trike units to selected cities (para. 22) and areas to replace ICE tricycles. The supply contract will include a standard warranty on mechanical and technical performance of the e-trikes. The risk of technical defects and poor performance of batteries during this guaranteed performance period (at least 3 years or 2,000 charges) will be borne by the battery manufacturer. All e-trikes will be clearly marked with a "battery supplied by" (similar to "Intel Inside" in computers) label to make consumers aware of the brand and obligations of the suppliers under the project.

14. **Output 2: Battery supply chain.** The project will initiate creation of a lithium-ion battery supply chain in the Philippines by creating an initial substantial market.[16] The transformation objective is to attract reputable international suppliers that have supplied at least one large global vehicle brand.[17]

15. **Output 3: Solar charging stations.** The project will establish (i) on a pilot basis five off-grid solar charging stations—200 kilowatts each—either as a cluster or stand-alone, and (ii) certain number of grid-connected charging stations. The solar charging stations will be

[13] The National Framework Strategy on Climate Change, 2010–2022 (http://climate.gov.ph).
[14] Department of Energy's Fueling Sustainable Transport Program (accessible from the list of linked documents in Appendix 2).
[15] ADB. 2011. *Country Operations Business Plan: Philippines*, *2012–2014*. Manila (http://www.adb.org/sites/default/files/cobp-phi-2012-2014.pdf).
[16] By April 2012, Nissan had sold about 11,000 electric cars (Nissan Leaf) in the United States, which required about 264 megawatt-hours of lithium-ion batteries—the 100,000 e-trikes will need at least 300 megawatt-hours of lithium-ion batteries.
[17] International Energy Agency. 2011. *Technology Roadmap*. {City} (Table 5A: Manufacturers of EVs/PHEVs and partnering battery manufacturers, electric and plug-in hybrid electric vehicles, June).

sufficient to support the electricity needs of 1,000 e-trikes. Some pilot solar charging stations will be in island locations that ae easily accessible and will adopt large number of e-trikes under the project, for example, Puerto Princesa. In all areas, certain number of grid-connected charging stations will be included to reduce the "range anxiety" of drivers. Private sector will be encouraged to invest in solar charging stations and in some cases, where feasible, the aggregated demand of the drivers will be converted into an equivalent 5-year power purchase agreement to reduce off-take risks of potential private investors. In addition, existing electric utilities will be encouraged to establish charging stations as commercial operation.[18]

16. **Output 4: Material recovery.** The project will collect old ICE tricycles (both the sidecar and the motorcycle), following the requirements of the United Nations Framework Convention on Climate Change. Used batteries (lead-acid ones from ICE tricycles and lithium-ion ones from e-trikes) will also be recovered.[19]

17. **Output 5: Communication, social mobilization, and technology transfer.** All stakeholders will be educated about the project—its benefits, technical parameters, costs, and market potential of e-trikes. This includes specific training of the drivers on use and maintenance of e-trikes and technical training to other stakeholders to develop local human resources to support local industry development.

D. Investment and Financing Plans

18. The project is estimated to cost $504 million (Table 1). ADB will provide $300 million from its ordinary capital resources, with a 15-year term, including a grace period of 5 years, an interest rate determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility,[20] and a commitment charge of 0.15% per annum, and such other terms and conditions as set forth in the draft loan and project agreements. Based on such loan terms and repayment method, the average loan maturity is 11 years and there is no maturity premium payable to ADB. The CTF will cofinance the project with a grant of $5 million ($1 million for capacity building and $4 million for a solar charging pilot) and a loan of $100 million, with a 40-year term, including a grace period of 10 years, a management fee of 0.18%, 2% principal payment (years 11–20), 4% principal payment (years 21–40), and an interest charge of 0.25% of disbursed and outstanding credit balance. An additional 5% management fee will apply for the $5 million grant. ADB will administer the CTF funds. CTF funds will be used to blend with ADB's investment and to fill the investment gap. ADB will finance the financial charges during construction for both ADB and CTF loans. The project will likely receive payments (about $20 million) for carbon credits after it is implemented. The government will finance the remaining $99 million, including taxes and contingency amounts for the e-trikes.

[18] E-Trikes Charging Infrastructure (accessible from the list of linked documents in Appendix 2).
[19] Disposal of Internal Combustion Engine Tricycles (accessible from the list of linked documents in Appendix 2).
[20] The government's choice to borrow under LIBOR-based lending was its own independent decision.

Table 1: Project Investment Plan[a]
($ million)

Item	Total
A. Base Cost[b]	
1. E-trike components	
a. Lithium-ion battery	118.80
b. Body and other parts	211.20
c. Motor	37.84
2. Supporting infrastructure	
a. Charging stations	0.48
b. Battery recycling	2.30
c. Old tricycles disposal/recycling	2.64
d. Communication, social mobilization, and administrative support	0.87
e. Solar charging station pilot	4.00
3. Consulting support	
a. Technology transfer and local industry support	0.87
b. Implementation consultant	0.87
Subtotal (A)	**379.86**
B. Contingencies[c]	
1. Physical	44.38
2. Price	14.07
Subtotal (B)	**58.45**
C. Taxes	**51.25**
D. Financial Charges During Construction[d]	**14.44**
Total	**504.00**

[a] Includes taxes and duties, government's contribution will be as tax exemption.
[b] In mid-2011 prices.
[c] Physical contingencies (11.6% for foreign and 12.6% for local base costs). Projected price contingencies use the differential between international inflation rate and inflation rate on local currency costs.
[d] Includes interest during construction and commitment charges. Interest during construction for Asian Development Bank (ADB) loan(s) has been computed at the 5-year London interbank offered rate fixed swap rate plus a spread of 0.4%. Commitment charges for an ADB loan are 0.15% per year to be charged on the undisbursed loan amount. The ADB loan may finance local transportation and insurance costs. This covers interests accrued from both ADB and Clean Technology Fund loans.
Source: ADB estimates.

Table 2: Financing Plan

Source	Amount ($ million)	Share of Total (%)
Asian Development Bank	300.00	59.53
Clean Technology Fund (loan)	100.00	19.84
Clean Technology Fund[a] (grant)	5.00	0.99
Government	99.00	19.64
Total	504.00	**100.00**

[a] inclusive of 5% MDB fee
Source: Asian Development Bank estimates.

E. Implementation Arrangements

19. As the executing agency, DOE will be responsible for overall implementation, technical supervision, and execution of the project. It will oversee and coordinate implementation, monitoring, and evaluation of the program; execute contract of sale agreements with the LGUs to ensure effective implementation; and establish and oversee the project management unit. DOE will lead in all project procurement activities, including management of the supply and service contracts of various suppliers. The E-Trike Project Management Unit (PMU), which will

include DOE organic staff with support from project consultants, will be responsible for direct management and supervision of the overall operation of the project. Secretary DOE will also chair the Coordinating Committee, which includes, among others, the Climate Change Commission. DOE will establish a e-trike office at each of participating LGUs. ADB will establish an internal advisory group to ensure that the project benefits from high quality technical feedback from ADB's Sustainable Transport and Climate Change professionals during project implementation.

20. LGUs will be involved in the project as they are the regulator of the tricycles in the country. LGUs are able to manage the credit risk of the drivers as the regulator of all tricycle related issues in an LGU. Most of this drivers have no collaterals and are unable to borrow from the bank. Some financing may be available from other formal and informal sources with interest rates varying from 3% to 10% per month.

21. The Land Bank of the Philippines (LBP), which has long lending relationship will the LGUs, will pay the Bureau of Treasury of the Department of Finance the amount disbursed by ADB under the loan for the supply of e-trikes. LBP will recover this amount from the LGUs, which will repay LBP the amount paid to the Bureau of Treasury within 5 years with an interest rate of 7.0%.

22. The project will replace existing tricycles (ICE motorcycles with a sidecar) in the following order of priority: two-stroke tricycles, driver-owned tricycles, and older tricycles. ADB and DOE will approve the selection criteria for each area—in areas where the number of single-stroke tricycles is low drivers may be selected by a public lottery among the applicants. DOE and ADB will select a neutral party or a participating nongovernment organization to conduct public lotteries. All data related to the selection of drivers, will be publicly disclosed through the project websites. Selected recipients will pay a maximum interest of 9.5% over the cost of the e-trikes from the supplier. The drivers will repay this amount through daily rental payments of over a 5-year period.

23. The tricycle regulatory office at each LGU will continue its regulatory roles and the e-trike project office will undertake project specific roles. Collection of boundary payment from drivers may be outsourced to a third party where possible, and will be outside the influence of the Tricycle Regulatory Office of an LGU. Services that could be competitively sourced, may be added as "associated services" and will be provided by the bidders in each region. A project website will disclose all quarterly progress report from all LGUs involved in the project including weekly collection from the drivers. The website will be used a way of monitoring and controlling implementation.

24. To avoid the establishment of a national monopoly for the supply of e-trikes, it is proposed that at least three vehicle manufacturers/assemblers will be selected through international competitive bidding for the supply and support of the vehicles in the Philippines in accordance with ADB’s Procurement Guidelines (2010, as amended from time to time). The project will be organized into two phases: (i) a development phase during which certain geographic supply packages will be procured to allow new operators to gain a foothold, plus allow the project to solve any initial implementation issues; and (ii) a scale-up phase. The industry development phase is planned to last 24–30 months, and a midterm review will conclude this phase. The midterm review will finalize the cities to be included in phase 2. The industry development phase will initially procure 20,000 e-trikes; the remaining 80,000 units will be manufactured and distributed over the remaining period of 30–36 months.

25. The following criteria were used for selecting cities: (i) the LGU leadership's commitment and interest in e-trikes, including own previous initiatives; (ii) commitment to set up public electric charging infrastructure; (iii) large number of ICE tricycles in the area, and (iv) the electricity supply and demand situation. Accordingly, the following 16 areas were chosen for the industry development phase: Antipolo, Boracay, Cabanatuan, Caloocan, City of Manila, Dagupan City, Davao, Lipa City, Los Banos, Makati City, Mandaluyong City, Paranaque City, Puerto Princesa City, Quezon City, Sta. Cruz, and Tarlac City.

26. The overall implementation schedule is conservative, taking into account the nascent state of the industry. The implementation arrangements are summarized in Table 3 and described in detail in the project administration manual (PAM),[21] which also includes details on the selection process for the drivers.

Table 3: Implementation Arrangements

Aspects	**Arrangements**		
Implementation period	October 2012–September 2017 (60 months)		
Estimated completion date	September 2017		
Management			
(i) Oversight body	Project steering committee headed by the secretary of the Department of Energy (DOE) (chair), with the National Economic and Development Authority, Department of Transportation and Communication, and Department of Environment and Natural Resources as members		
(ii) Executing agency	Department of Energy. DOE will establish a project management unit to be responsible for overall management and supervision of project implementation.		
(iii) Key implementing agencies	Local government units (LGUs) involved. First procurement package includes Puerto Princesa, Boracay, Mandaluyong City, and Cabanatuan City.		
(iv) Implementation unit	Each LGU will create an e-trike office that will be responsible for local implementation and monitoring of the project.		
Procurement: Industry development phase	International competitive bidding with domestic preference	Procurement of assembled vehicles with associated warranty and support services	$110.64 million
Procurement: Scale-up phase	International competitive bidding with domestic preference	Procurement of assembled vehicles with associated warranty and support services	$216.25 million
Consulting services	Quality- and cost-based selection and quality-based selection	119 person-months (project implementation consultant)	$1 million
	Single-source selection (individual consultants)	36 person-months (technology transfer and local industry support, communications)	$1 million
Advance contracting	Advance procurement of 5,000 e-trikes.		
Disbursement	Direct payment for procurement packages. Separate imprest account for the Clean Technology Fund (CTF) and the Asian Development Bank (ADB) for administration and other categories. The ADB loan and CTF loan grant proceeds will be disbursed in accordance with ADB's *Loan Disbursement Handbook* (2007, as amended from time to time).		

Source: Asian Development Bank.

[21] Project Administration Manual (accessible from the list of linked documents in Appendix 2).

III. DUE DILIGENCE

A. Technical Assessment

27. According to the Massachusetts Institute of Technology (MIT),[22] more efficient battery technologies are providing a cleaner alternative to pollutant-emitting ICEs. In many cases, conventional motorcycles cause more pollution than even large SUVs because they are not equipped with equivalent emission-control technology. Electric motorcycles can immediately eliminate tailpipe emissions, and can dramatically reduce a city's overall pollution rate. Greenhouse gas emissions could be negligible, as these e-vehicles can be powered with renewable energy, especially solar.

28. The United States Department of Energy views lithium-ion battery technology as one of the most promising new battery options, thanks to its high energy and power densities and its potential to last the lifetime of the vehicle.[23] In 2008, MIT's electric vehicle team designed eMoto[24] and found that use of lithium-ion batteries could reduce the weight of an e-vehicle battery pack by up to 76%, from 93 kilograms (kg) to 23 kg. The lighter vehicles with a longer battery life proved to be more cost-efficient and were able to travel farther and accelerate faster than models using heavier battery equipment. ADB's pilot project compared different e-trike options: the lithium-ion batteries (38 kg) were 72% lighter than the lead-acid ones (140 kg).

29. The 20 e-trikes of the pilot project used different battery-size and charging options: 10 e-trikes with 3 kilowatt-hour (kWh) batteries for fast (20 minutes) charging in public stations, and 10 e-trikes with 6 kWh batteries with on-board chargers for home charging (6 hours). The pilot concluded that (i) lithium-ion batteries are the sustainable battery choice; (ii) properly designed e-trikes are capable of meeting the variable range, speed, and terrain considerations in the Philippines; (iii) fast charging is possible and can be locally designed and built; (iv) due to sophisticated battery and charging technologies, the drivers and LGUs will not be able to manage the risk of a faulty battery; and (v) the fuel savings are significant and are sufficient to support a rent-to-buy e-trike scheme for the drivers. The e-trikes financed by this project will use lithium-ion batteries.

B. Sustainability

30. Local support infrastructure and technical capacity is an essential prerequisite for the project. In 2008, one Manila city bought 200 e-trikes (with lead-acid batteries). Unfortunately, fewer than 10 are still operating. Apart from the main problem of lack of cash to replace lead-acid batteries within 12–15 months, lack of ongoing technical support contributed to this failure. The lesson from the Mandaluyong pilot is similar: to make the e-trike initiative sustainable, an essential prerequisite will be a vibrant local industry that will provide, among others, skilled technicians, repair and support services, insurance, charging stations, and spare parts.

31. The project will transform the risk allocation: the owner of e-trikes will not absorb the risks associated with this new technology; the battery manufacturers are best placed to manage

[22] MIT. 2007. *The Technology Review* (http://www.technologyreview.com/energy/19069/).
[23] Center for Transportation Research Argonne National Laboratory, operated by The University of Chicago, for the United States Department of Energy (http://www.transportation.anl.gov/pdfs/TA/149.pdf).
[24] An electric motorcycle that demonstrated the feasibility of low-cost e-vehicles (http://web.mit.edu/evt/emoto.html).

the risk of poor-performing batteries. By backing off the risk of unreliable batteries through the supply chain, via the vehicle supplier, the risk will be allocated to the battery maker.[25]

C. Financial Analysis

32. Broadly, a typical tricycle driver uses about $5 worth of gasoline (5 liters) to drive 100 kilometers (km) per day,[26] but can save about $4 per day by switching to an e-trike, which consumes 5 kWh of power costing $1.[27] With large-scale adoption, these individual savings could accumulate to significant national savings of over $4 billion per year. Replacement of 100,000 gasoline tricycles with e-trikes at a cost of $450 million, for example, can generate about $175 million each year from avoided fuel imports. Detailed financial analysis was carried out in real terms using 2011 prices that examined the aggregate costs and incremental benefits measured by the revenue from drivers or users. The overall financial internal rate of return exceeds 48% from the driver's point of view.[28]

D. Economic Analysis

33. The project's economic analysis is based on incremental cost and benefit streams associated with the project component, whose economic performance is evaluated by comparing "with project" and "without project" scenarios. Benefits are derived mainly from the fuel savings or avoided costs from the importation of fuel, and income from the boundary payments of drivers and users. The overall economic internal rate of return is about 54.09%, which exceeds the economic hurdle of 12%.[29] This indicates that the project, from the perspective of the government, is economically viable.

E. Governance

34. ADB's Anticorruption Policy (1998, as amended to date) was explained to and discussed with the government and DOE. The specific policy requirements and supplementary measures are described in the PAM (footnote 21). To ensure transparency and good governance, DOE will publicly disclose on its website information on how loan proceeds are being used. For each procurement contract, LBP and DOE will disclose (i) the list of participating bidders, (ii) the name of the winning bidder, (iii) basic details on bidding procedures adopted, (iv) the amount of the contract awarded, (v) a list of goods and services purchased, and (vi) the intended and actual utilization of loan proceeds under each contract being awarded. ADB will organize special training for LBP, DOE, and project management unit staff covering all aspects of project implementation and ADB procedures, including procedures for implementation, procurement, use of consultants, disbursement, reporting, monitoring, and prevention of fraud and corruption.

F. Poverty, Social, and Gender

35. An e-trike will result in a higher daily take-home pay for its driver. In Davao, 92% of drivers were renters, and about 80% were married with about three dependents, and 70% had a

[25] Details of the risk management framework and market dynamics before and after the transformation using Porter's model of competitive analysis are in E-Trikes Charging Infrastructure (accessible from the list of linked documents in Appendix 2).
[26] Tricycles in Boracay, with its hilly terrain and heavy traffic, use about 6 liters ($8.20) to drive about 30 km per day.
[27] Assumes cost of power of 20 cents/kWh in the Philippines, one of the highest in the region.
[28] The financial internal rate of return calculation is in Financial Analysis (accessible from the list of linked documents in Appendix 2).
[29] Economic Analysis (accessible from the list of linked documents in Appendix 2).

secondary degree. In Boracay, about 40% of drivers are owners. The fuel cost savings of P200 per day will greatly benefit the driver community and are the basis for the rent-to-own scheme. The project will not displace, or negatively affect the livelihood of, tricycle drivers or families. Since fabrication and assembly could be largely domestic, the project could create a net employment gain of around 10,000 jobs by 2015. The project is not expected to have a significant effect on the oil-fueled local tricycle assembly industry in the short term.

36. The pilot e-trike design has accounted for women's needs with better seating arrangements. Female passengers will be consulted on the design and safety aspects of proposed e-trike models, especially for Metro Manila, where female ADB personnel will be used as a focus group. As this is a replacement program, the scope for female drivers will be limited. ADB's target is for at least 30% of charging station jobs to be filled by women (only for daytime shifts). Female workers will also be trained to inspect the e-trikes for basic safety issues (road-worthiness, for example) and collection of e-trike data on every charge. The health and safety benefits of the new design will be significant for the population, especially children.

G. Safeguards

37. The project is categorized as C for environment, involuntary resettlement, and indigenous peoples. The e-trikes will have no tailpipe emissions and no engine noise. Because the project is classified as category C, no separate environmental assessment will be required, although environmental implications need to be reviewed. According to ADB's publication on electric bikes,[30] lead pollution is an inherent problem with e-vehicles, and electric bikes with lead-acid batteries will increase overall pollution rates more than ICE motorcycles. Lithium-ion batteries, however, are not an environmental hazard,[31] are classified by the Government of the United States as nonhazardous waste,[32] and are safe for disposal in the normal municipal waste stream.

H. Special Features

38. The project uses financing from Climate Investment Fund[33] as an integral part of the project design for market transformation. The market transformation envisaged under the project aims at (i) access to and commercialization of technology; (ii) transforming service delivery arrangements; (iii) introducing publicly available charging stations for e-vehicles; and (iv) gradual indigenization of the e-trike industry.
The project aims to create an internationally competitive local e-vehicle industry using latest battery and charging options, including solar charging. The project will ensure ongoing competition where possible to prevent market inefficincies, and "regulate" where necessary, with the ultimate aim that sufficient competition exists across the entire value of the e-trike industry.

39. **Development Impact**. The use of CTF resources to support the expansion of electric vehicles in the country will not only contribute to the country's low-carbon development objectives but will also help reduce the country's reliance on imported energy sources for the transport sector. Other developmental benefits will include better health for drivers, passengers and urban residents generally through improved air quality, new skills development, job creation, and establishment of a vehicle and spare parts supply industry. The proposed project

[30] ADB. 2009. *Electric Bikes in the People's Republic of China: Impact on the Environment and Prospects for Growth.* Manila.
[31] http://www.ehso.com/ehshome/batteries.php
[32] http://www.epa.gov/osw/hazard/wastetypes/universal/batteries.htm
[33] Cofinancing with the Clean Technology Fund.

also includes provision for the testing of solar charging stations from e-vehicles, which is expected to create an enabling environment for related private sector investments and technology risk sharing. Further, the additional net income of e-vehicle drivers and owners should largely be poured back into the participating communities.

40. **Clean Development Mechanism.** The project is likely to be registered under the Clean Development Mechanism of the Kyoto Protocol. Considering the large renewable energy component of the Philippines' electricity grid, and the inherent efficiency of the electric motors, the emissions from the e-trikes would be significantly less than from the fossil-fuel consumption of the gasoline-driven tricycles, i.e., the baseline scenario. Potential for emission reduction per e-trike, distributed and operational, is likely to be approximately 3.8 tCO_2e.[34] The project has applied for registration under the Clean Development Mechanism and, if registered, the project would generate certified emission reductions.

I. Risks and Mitigating Measures

41. Major risks and mitigating measures are summarized in Table 4 and described in detail in the risk assessment and risk management plan.[35]

Table 4: Summary of Risks and Mitigating Measures

Risks	Mitigating Measures
Poor-quality e-trikes undermining technology credibility and project viability	Prequalified bidders will supply independently designed e-trikes built to international safety standards that are competitively priced through international bidding. In most case, the units will be locally made, and the suppliers will provide after sales support and at least 3-years warranty on all parts. Tight quality-control and performance monitoring measures will be applied at all levels.
Use of e-trikes to influence the 2012 LGU election.	In the Philippines, elections for local governments are held every 3 years. Most ODA-funded projects including for local governments thus cut across election cycle and have to include measures to mitigate risks emanating from elections and the underlying democratic processes. ADB and DOE will be hands on involved in the selection process of the e-trike recipients. Only two areas—Puerto Princess and Boracay are likely to see some units (about 40 e-trikes) financed by ADB before the LGU election within the next 7 months (April 2013) out of the 100,000 e-trikes to be introduced by the project over the next 5-years.
Substandard Li-ion batteries will be selected through international bidding under the project	Strict minimum technical standards and commercial qualification criteria will ensure that only products from reputable international manufacturers are incorporated into the vehicles. ADB's direct payment for the supplied battery staggered over a 36-months period will ensure suppliers have the right financial incentive to supply quality batteries and honor warranties.
Excess financing cost because of multiple intermediaries	The Asian Development Bank worked closely with the government to ensure that the drivers or owners pay single-digit interest rates for the rent-to-own scheme.
Crowding out of the private sector	The term "crowding out" does not apply fully as the project scope is limited to 100,000 units out of the 3,500,000 tricycles that are currently operational in the Philippines. There are currently no active banks selling financial products specifically for electric tricycles. The project will create market for a new product by eliminating technology risk and creating enabling public infrastructure—public charging, access to quality battery, warranty, broad based technical capability, and a public domain professional e-trike design (drawing and component specifications) for all to built. To attract private investment and create demand, in most

[34] Assumptions: 80 km/day; 15 km/liter on gasoline tricycle; emission factor of baseline vehicle = 146.93 gCO_2/km.
[35] Risk Assessment and Risk Management Plan.

	cases, the project will cover only a part of the tricycle population—for example, 4000 e-trikes in an area where 20,000 tricycles operate—so that the induced demand for e-trikes for replacing the remaining tricycle population could be met by the competent private suppliers.
Inadequate demand for e-trikes discouraging new investment	The industry development phase will cover only 20,000 e-trikes. Before embarking on distributing the 80,000 e-trikes under the "Scale Up" phase, a proper technical and commercial assessment will be made of industry development phase.
Inadequate capacity of local industry to meet demand	Procurement will be phased to ensure a ramp-up period for early adoption and new investments and technology transfer.
Poor disclosure of e-trike design data and others information inhibiting growth in this nascent industry.	Under the project website (http://www.adb.org/etrike) and DOE website individual sites will be established for the e-trike office in each participating LGUs. These website will periodically disclose information of different aspects of the project: technical data, e-trike recipient information, performance monitoring, fuel savings and feedback of users.

Source: Asian Development Bank.

IV. ASSURANCES

42. The government has assured ADB that implementation of the project shall conform to all applicable ADB policies, including those concerning anticorruption measures, safeguards, gender, procurement, consulting services, and disbursement as described in detail in the PAM and loan documents. The government has agreed with ADB on certain covenants for the project, which are set forth in the loan agreements and grant agreement.

Appendix 1: DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and/or Reporting Mechanisms	Assumptions and Risks
Impact Sustainable energy use by the transport sector	Fuel used by the transport sector is reduced by at least 2.8% (2010 baseline: 20 million barrels per year consumption) or an equivalent of 89.2 million liters of gasoline per year. Pollution in selected cities reduced by at least 20% (from the baseline measurement under the project)	Data published by DOE	**Assumptions** Sufficient renewable energy investment in the power sector across the country Public transport use pattern will not be altered significantly by introduction of cheap (electric) fuel. **Risks** Uncontrolled growth of electric vehicles (e-vehicles) across the country Cheaper and poorer-quality e-vehicles flooding the market
Outcome Tricycle industry transformation through large-scale adoption of locally made energy-efficient electric tricycles (e-trikes)	At least five companies are established that are registered by the Board of Investments as new industries. At least two retailers distributing (and assembling) lithium-ion and other high-energy-density batteries locally At least 50% of the conversions outside the project boundary using lithium-ion batteries About 10,000 jobs created in this new industry by 2016, from less than 100 people in 2011.	Data published by the LGUs collected by project implementation consultants Published reports by DOE and the Board of Investments Market survey during the midterm review	**Assumptions** Locally made e-trike will meet its expected design life. Enough local technical expertise is available to support the local industry. **Risks** Oil price will not drop significantly from its current high level. Significant increase of electricity prices and power shortages in specific areas Local e-trike business becomes unviable because of cheaper imports
Outputs <u>1. E-trike units</u> Complete e-trike units delivered to LGUs with standard 3-year warranty <u>2. Battery supply chain</u> Lithium-ion battery supply chain, including support infrastructure, created	At least 17,000 e-trikes operating by December 2013, 50,000 by 2014, and 100,000 by 2015 At least three internationally reputable battery companies established active presence in the Philippines by 2014 (from none in 2011)	Project reports TRU reports Industry commission and Board of Investments reports Report from Securities and Exchange Commission	**Assumptions** The project will transform local industry and will be able to attract overseas investors to partner with local businesses, enabling technology transfer and employment generation. Government commitment to e-trikes will continue and the government will resolve registration and franchise issue across the country. Acceptance of e-trikes by drivers and passengers is ongoing.

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and/or Reporting Mechanisms	Assumptions and Risks
	At least two reputable motor suppliers by 2012		The project will be able to attract reputable lithium-ion battery manufacturers/suppliers in the Philippines. Local manufacturing will be able to meet the project demand. **Risks** Involvement of multiple layers of intermediaries increases financing cost Resistance of businesses using current technology Capacity of industry insufficient to meet local demand Stakeholder acceptance of rent-to-own e-trike scheme Accidents and unforeseen events undermining e-trike technology
<u>3. Solar charging stations</u> Solar and other charging stations available in selected areas to meet the public charging needs	Five solar charging stations of 200 kilowatts each will be established. At least 500 locally assembled charging stations are installed in selected project areas. At least 30% of operators of public charging stations will be women (only for daytime shifts).		
<u>4. Material recovery</u> Collection of used batteries and old ICE tricycles: (i) recycling of lithium-ion batteries and (ii) body disposal	Battery-recycling options studied and pilot operating Old tricycles collected and disposed of as per the United Nations Framework Convention on Climate Change's requirements and local environmental rules.		
<u>5. Communication, social mobilization, and technology transfer</u>	Consumers are aware of benefits of e-vehicles (three workshops) and at least six companies selling in Metro Manila with service support by December 2012.		

Activities with Milestones	Inputs
1. E-trike units 1.1 Sign memorandum of agreement between DOE, Lang Bank, and LGU (intermittent per LGU) (1 September 2012–30 September 2012) 1.2 Finalize prequalification and bidding documents for goods package (1 June 2012–30 June 2012) 1.3 Conduct prequalification and bidding documents for goods package (30 June 2012–30 September 2012) 1.4 Conduct procurement activity from advertisement, bid submission, and bid evaluation to contract award (intermittent eight packages, 1 August 2012–30 March 2016) 1.5 Deliver and distribute e-trikes to LGUs (for drivers) and sign supply and maintenance agreement between supplier and LGU **2. Battery supply chain** 2.1 Conduct procurement activity and sign supply and maintenance agreement between suppliers and LGUs (for drivers) (see output 1 schedule) (1 August 2012–30 March 2016) 2.2 Establish a service center per LGU (1 March 2012–29 March 2013) **3. Solar charging stations** 3.1 Select electricity provider for each area (1 January 2012–31 May 2014) 3.2 Sign each memorandum of agreement between electricity provider, LGU, and	($ million) ADB CTF (loan) $300.00 CTF (grant) $100.00 Government $5.00 $99.00

DOE (1 January 2012–31 September 2012) 3.3 Finalize technical specifications for charging stations per LGU (1 January 2012–31 September 2012) 3.4 Conduct procurement activity from advertisement, bid submission, bid evaluation to contract award, turnkey package for solar charging stations in Boracay and Puerto Princesa (1 July 2012–31 December 2012) 3.5 Install solar charging stations (1 January 2013–31 May 2013) **4. Material recovery** 4.1 Finalize material recovery plan for batteries and old tricycles (1 April 2012–31 August 2012) 4.2 Allocate budget for each LGU and designate area for collection and disposal (1 July 2012–31 December 2015) 4.3 Develop database of old tricycles in each LGU (1 January 2012–31 December 2016) **5. Communication, social mobilization, and technology transfer** 5.1 Conduct implementation-related training for project management unit, selected LGUs, and other related agencies, and establish technical working group to prepare material recovery plan (intermittent, 1 January 2013–31 May 2016) 5.2 Prepare and implement general information, education, and communication plan for each LGU (1 January 2013–31 May 2015) 5.3 Undertake training and workshop on technical operation and maintenance of e-trikes (1 January 2013–31 August 2016)	

ADB = Asian Development Bank, CTF = Clean Technology Fund, DOE = Department of Energy, LGU = local government unit.
Source: Asian Development Bank.