

## **ECONOMIC ANALYSIS**

### **A. Approach**

1. The economic analysis includes an assessment of the sustainability of project long term effects to ensure that: (i) the project provides a sufficient incentive for future investors in the Philippine e-Trike industry; (ii) sufficient funds and technical capacity will be made available to maintain project operations; (iii) the distribution of project benefits, costs and risks are consistent with the broad long term objective of market transformation; and capability of the parties; and (iv) external environmental and social effects are included in the analysis, whether quantified or not.

2. The market transformation design further distinguishes between productive efficiency (producing e-Trikes and services at minimum cost through competitive bidding), allocative efficiency (ensuring that concessional resources are used to produce goods and services that produce the maximum benefit to the drivers, the passenger, and others on the road through increased safety), and dynamic efficiency (ensuring that use of e-Trikes or consumption and future investment decisions lead to most efficient outcomes over time, in the face of changing conditions without any market distortions). There are no subsidies included in the project design.

3. Economic analysis was performed for the project and its variants to determine whether its economic returns were satisfactory and that money invested in them would achieve development objectives equivalent to or better than alternative investments. The various analyses were carried out using discounted cash-flow techniques to derive economic internal rates of return (EIRRs). The economic hurdle of 15% was used as a benchmark, as issued by the National Economic Development Authority (NEDA).

### **B. Development Impact**

4. Through the use of highly concessional Clean Technology Fund (CTF) resources to support the expansion of e-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 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.

### **C. Economic Costs**

5. The project costs include materials and labor, all valued before tax. No price contingencies are included in the base capital cost, but the economic capital costs include physical contingencies of about 5%. Costs were separated into foreign exchange and local costs using a ratio of 60:40 (foreign goods: domestic goods). A shadow exchange rate factor of 1.2 was used. The labor cost on the other hand was disaggregated as skilled and unskilled labor using a 70:30 ratio (skilled: unskilled). A shadow wage rate factor of 0.60 was used, as issued by NEDA.

6. Annual operation and maintenance and administration costs were calculated in economic prices. The following assumptions were made in conducting the economic analyses:

- (i) Annual operating and maintenance costs are based on expected costs based on different of life of equipment that will be required to be replaced periodically, for example: tires, brakes, cables, bearings, motor rewinding and controller maintenance,
- (ii) The electric tricycle is expected to have an economic life of 10 years. To cater for the units to be purchased and delivered in 2015 and 2016, the economic life of the project is assumed to be 15 years.
- (iii) A discount rate of 15% is assumed.
- (iv) Technical and operations data for each e-Trike are shown in Table 1 below.

**Table 1: e-Trike Technical and Operations Data**

<b>Item</b>	<b>Unit</b>	<b>Value</b>
Fuel type		lithium-ion battery
Unit cost	\$	4500
Battery capacity	kWh	6
Battery life	cycles	2000
Range per full charge	km	80
Daily distance travelled	km/day	80
Number of charging per day	times	1
Charging efficiency	percent	90%
Daily electricity consumption	kWh/day	6.7
Electricity price	P/kWh	9.8
Average gross income of drivers	P/day	800

km= kilometer, kWh= kilowatt hour, P= Philippine peso

#### **D. Economic Benefits**

7. The primary economic benefits of the project are fuel savings or avoided costs on the importation of fuel from the national perspective. The other obvious benefits are: cleaner environment as e-Trike will generate no air or noise pollutions, create local employment and reduce road accidents, especially on national highways because of the safer design of the e-Trike including better road visibility for the drivers. For the purpose of this analysis, however, only the primary benefits are used for quantification of the benefits.

#### **E. Economic Internal Rate of Return Calculation**

8. The internal rate of return is a discount rate calculated so as to equalize the net present value of cost with that of benefit. A calculation period of 15 years (2013-2028) is used to cover the full life-cycle of the e-Trikes under the project for the project duration (2013-2017). It is assumed that there will be sufficient supply of e-Trike in the market for a driver to replace the units under the project after its economic life. Also the 10 year life of e-Trike is conservative. The cost of depreciation of the lithium ion battery (hence its replacement cost every 5 years) is

included in the analysis. The Economic Internal Rate of Return (EIRR) of 23.26%, as shown in Table 2.

**Table 2: Table 2: EIRR and Economic NPV Results**  
(\$million)

Year	Economic Cost	O&M Cost	Fuel Savings	Net Benefits
2013	35.5	0.7	0.0	(36.2)
2014	65.9	2.1	9.7	(58.2)
2015	101.4	4.1	27.7	(77.8)
2016	152.0	6.2	55.4	(102.8)
2017	152.0	8.2	97.0	(63.3)
2018		10.3	138.5	128.3
2019		10.3	138.5	128.3
2020		10.3	138.5	128.3
2021		10.3	138.5	128.3
2022		10.3	138.5	128.3
2023		9.5	138.5	129.0
2024		8.2	138.5	130.3
2025		6.2	138.5	132.4
2026		4.1	138.5	134.4
2027		2.1	138.5	136.5
2028		0.0	138.5	138.5
Economic Net Present Value (NPV) @ 12%				<b>202.97</b>
Economic Internal Rate of Return (EIRR)				<b>23.26%</b>

( ) = negative, EIRR = economic internal rate of return, NPV = net present value,  
O&M = operation and maintenance

Source: ADB Staff estimates

## F. Conclusions

9. The economic analysis confirms that the project is sustainable. The analysis reflects the national fuel cost savings are significant even discounting all other societal benefits, and funds are sufficient for continuing operation of the e-Trikes. Sensitivity analysis shows the EIRR being reduced to 17.5% for a 20% reduction in the price of imported oil. The quantification shows the overall benefit outweighs the costs. Based on the economic analysis the project's net present value is \$132 million, and the EIRR of 23.26% exceeds the economic hurdle of 12%. This indicates that the project, from the perspective of the government, is economically viable.