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The New Chance of Electric Scooter Equipped with Lithium Ion Battery in Taiwan

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Abstract

The air pollution in metropolitan area of Taiwan caused by the nearly 15 million internal combustion engine (ICE) motorcycles has become a big issue and need to be improved urgently. One of the most effective ways to reduce the air pollution problem is suggested applying the electric scooter (E-scooter) to substitute the ICE motorcycle. Besides, this implementation of E-scooter industry also can extend to promote the industrial development in the key components such as electric motor, motor controller, traction battery, etc. In 2009, Taiwan Government had issued one pronouncement, Taiwan Electric Scooter Standard (TES), for testing the E-scooter performance and safety. In order to make this policy of E-scooter on road come true, a series of aggressive promotion strategies were leaded by government and cooperated with the related organizations, industrial companies, and business service systems. Hopefully, the consumers' safety can be carefully considered on the initial stage of E-scooter propagation in Taiwan. In addition, the vehicle performance and safety quality of domestic E-scooter can be promoted simultaneously too.

Keywords: lithium battery, electric scooter, standardization, vehicle performance, safety

1. Introduction

Nowadays, motorcycle has long time been the main transportation vehicle of Taiwanese people and nearly 15 million internal combustion engine (ICE) motorcycles have been registered. In which, including 26.5% light motorcycles and more than 70% of them agglomerated in the five metropolitan areas, thus causes the severe air pollution in the metropolitan area. Based on the analysis result of motorcycle usage, there is about 50% was used on the regular commute and about 16.9% was used on shopping, as listed in Table 1[1]. Since the driving range of all these usage is under 17 km/day, that this privilege circumstance provide the E-scooter an opportunity to substitute ICE on the transportation in the metropolitan area. In addition, this implementation of E-scooter industry also can extend to promote the industrial development in the key components such as electric motor, motor controller, traction battery, etc.

Table 1 Analysis of light motorcycle usage

Main usage	Percentage (%)	Daily driving range (km/day)
Commute	50	14.7
Shopping	16.9	6.2
Business	8.9	13.1
Sending and picking up	8.8	7.4

Go to school	7.4	16.1
Others	8	13.3

In 2009, Taiwan government had issued one pronouncement, Taiwan Electric Scooter Standard (TES), for testing the E-scooter performance and safety as listed in Table 2 [2]. At the same time, the detail criteria of performance and safety of vehicle, safety guidelines of detachable/fixed type lithium ion batteries, safety of charging system, and quality consistency of subsidization policy for the E-scooter are included in this pronouncement and as listed in Table 3 [2]. Hopefully, the consumers' safety can be carefully concerned at the early promotion of E-scooter. In addition, the vehicle performance and safety quality of domestic E-scooter can be improved simultaneously too.

Table 2 Taiwan Electric Scooter Standard

Category	Test Items	Methods
Performance and Safety of Vehicle	1.Climbing ability	TES-0A-01-01
	2.Top speed	TES-0A-02-01
	3.Acceleration	TES-0A-03-01
	4.Driving range	TES-0A-04-01
	5.Durability	TES-0A-05-01
	6.Low SOC warning	TES-0A-06-01
	7.EMC	TES-0A-07-01
	8.Special safety	TES-0A-10-01
Safety Guidelines of Battery	1.Structural requirements	TES-0A-08-01 (Detachable Battery) and TES-0A-08-02 (Fixed Battery)
	2.Installation and use	
	3.Connection requirements	
	4.Plug-duration	
	5.Withstanding voltage	
	6.Insulation resistance	
	7.Electrostatic discharge, ESD	
Safety Test of Lithium Battery	1.Pre-conditioning	TES-0B-01-01
	2.Overcharge	
	3.External short circuit	
	4.Partial Short circuit	
	5.Crush	
	6.Shock	
	7.Drop	
	8.Vibration	
	9.Thermal	
Safety of Charging System	1.Mandatory functions	TES-0A-09-01
	2.Protection against electric shock	
	3.Clearances and creep distances	
	4.Vehicle drive-over	
	5.IPX5	
	6.Earth resistance	
	7.Withstand voltage	TES-0A-09-02
	8.Insulation resistance	
	9.Touch current	
	10.Functional requirements	
	11.Service life	
	12.EMC	

Table 3 Criteria of Light level and Small light level for subsidy NT$7.200 and 10,000

Test Items		Criteria(Light level／Small light level)
Vehicle	Climbing ability	Over 10kph on 18% slope / Over 10kph on 12% slope
	Top speed	Over 45kph / More than 25kph
	Acceleration	0~100 meters, shall be less than 12 sec / 0~50 meters, shall be less than 9 sec
	Driving range	Over 30km driving range under specific driving pattern
	Durability	Accumulate mileage over 3,500km without Class A Fault during the test / Accumulate mileage over 2,300km without Class A Fault during the test
	Low SOC warning	Remaining mileage not less than 2km or the declared value after warning of low state of charge
	EMC	With reference to TES-0A-07-01
	Special safety	With reference to TES-0A-10-01
Lithium Battery	Detachable battery safety guidelines	With reference to TES-0A-08-01. The weight of each test battery shall not exceed 10kg.
	Fixed battery safety guidelines	With reference to TES-0A-08-02
	Safety	With reference to TES-0B-01-01
Charging system		With reference to TES-0A-09-01& TES-0A-09-02

2. Promotion bottleneck of Taiwan E-scooter

Since the announcement of subsidization policy of Taiwan E-scooter in 2009, so far there are eighteen models of E-scooter have been approved to get subsidy of NT$7,200-10,000 for purchasing each E-scooter by consumer, as shown in Table 4 and 5 [1]. However, up to December 2011, there are only 11,000 E-scooters were sold and are far beyond the target of selling 160,000 E-scooters in five years which was set by the government. The expectation drop may be attributed to the too high selling price of E-scooter equipped with lithium ion battery, similar price as the ICE motorcycle. In addition, the performance (such as driving range and climbing ability) and refueling infrastructure of E-scooter still could not meet the

requirement of consumer. How to effectively promote the E-scooter on road is still the major issue to be improved in the long run.

Table 4 TES approved E-scooter models for the level of NT$7,200 subsidy

Maker	Model	Driving range (km)	Speed (km/h)	Climbing ability (km/h @12%)
E-TON	e-MO EV3A 	Over 30	Over 40	Over 10
	e-MO EV3C 	Over 30	Over 40	Over 10
中華汽車	e-Moving EM198 (type A) 	Over 30	Over 40	Over 10
	e-Moving EM1A6 (type A) 	Over 30	Over 40	Over 10
	e-Moving EM198 (type B) 	Over 30	Over 40	Over 10
	e-Moving EM198 (YA140) 	Over 30	Over 40	Over 10
KYMCO	Sunboy EA10BB 	Over 30	Over 40	Over 10
SYM	e-star EA1LU 	Over 30	Over 40	Over 10
KENTFA	CC-888 	Over 30	Over 40	Over 10
YAMAHA	EC-03 ED-06 	Over 30	Over 40	Over 10

Table 5 TES approved E-scooter models for the level of NT$10,000 subsidy

Maker	Model	Driving range (km)	Speed (km/h)	Climbing ability (km/h @18%)
E-TON	IBA3 (TW types) 	Over 30	Over 45	Over 10
	IBA3 (JP types) 	Over 30	Over 45	Over 10
中華汽車	e-Moving EM1A6 (type B) 	Over 30	Over 45	Over 10
	e-Moving EM1A6 (20Ah YA11P) 	Over 30	Over 45	Over 10
KYMCO	EA10FA 	Over 30	Over 45	Over 10
SYM	ED1LU2 	Over 30	Over 45	Over 10
db-Life	DBX 	Over 30	Over 45	Over 10
EVT	EVT-4000 E-BLM1 	Over 30	Over 45	Over 10

3. Aggressive promotion strategies

(1) Decrease the purchasing cost:

- Exemption of license plate and commodity taxes.
- NT$2,000 to 17,000 additional subsidy of purchasing an E-scooter from 15 local governments.
- Extend the subject of subsidy to organizations, companies, schools, and enterprises.

(2) Improve the charging infrastructure

- NT$100,000 subsidies for establishing each one charging station in the places of

government, organizations, companies, schools, and enterprises.

- Encourage private company to run the swappable batteries business. NT$1.5 million subsidies for establishing each one battery exchange station.

(3) Encourage government offices to purchase the E-scooter instead of ICE motorcycle and set up the dedicated parking place for E-scooter.

(4) Encourage the consumer to replace the out-of-date high emission 2-stroke motorcycle by E-scooter and get NT$3,000 additional subsidies.

(5) Series of continuous counseling projects from government provide a budget to make up the expense of TES test for the manufacturers.

(6) Up to NT$20 million incentive award of selling over 16,000 sets of E-scooter to manufacturers.

(7) Enhance education and propaganda of TES in public media

4. Strategy for extending the driving range of E-scooter – Standardization of lithium ion battery

According to the character limitation of lithium ion battery, it will take 2 hours to fully charge one set of battery. This causes consumer's fear on the driving range of E-scooter because they need to save half battery power to drive them back to home. In order to dispel the consumer's doubts on the driving range of E-scooter, the charging system for E-scooters could adopt the concept of gas station system for the ICE motorcycles to establish the system of battery swapping station. These battery swapping stations can be distributed at the convenient stores, new set-up stations, and existing gas stations. However, there are 18 models E-scooter from 8 manufacturers have been approved by TES and equipped with 15 different types of lithium ion battery. The battery swapping system could not be established under the circumstance right now. Therefore, the standardization of lithium ion battery for E-scooter has been proposed by a strategic alliance which organized by the public enterprises, organizations, and related industrial companies. A common consensus of battery specification has been obtained and listed as:

(1) Output voltage: under 60 volt.

(2) Appearance dimension of battery case: 345±2 mm H × 152±2 mm L × 121±2 mm W.

(3) Weight: less than 10 kg.

(4) Connector:

- Position: located at the fixed place of case bottom.
- Pins: including 4 power pins and 6 signal pins.
- Current endurance of pins: 60 amperes for power pins and 2 amperes for signal pins.

(5) Communication protocol: CAN bus 2.0A [3]

Nevertheless, before standardizing the swappable lithium ion battery, a more detail specification of connector has to be worked out and is under discussing by the strategic alliance.

5. Conclusion

According to above series of aggressive encouragement policy and subsidization, an E-Team alliance [4] has been organized spontaneously by the vehicle rental companies, convenience stores, and major manufacturers of E-scooter, lithium ion battery, connector, and instrument of battery swapping station. This E-team is working to operate a novel business model with open energy farm infrastructure. This business model uses compatible batteries, detachable contact and same CAN communication protocol. Therefore, various TES qualified E-scooters can share the same energy farm infrastructure. The goal is to provide more convenient, reliable and ecological business model and environment to attract more E-scooter uses in the low carbon emission cities. Even through only 11,000 sets of TES approved E-scooter were sold up to December 2011, the E-scooter related industry still has the faith to widespread the E-scooter to the world successfully in the future.

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