

The Electric Vehicle Promotion Policy of Environmental Protection Administration in Taiwan

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Summary

The Environmental Protection Administration (EPA) in Taiwan has taken actions to improve air quality by reducing gas emission from sources, Promoting low-carbon vehicles by providing subsidies to support the purchases of two-wheel electric vehicles, electric buses and electric produce transporters throughout Taiwan. In 2020, the targets for low-pollution vehicle promotion by subsidization are the elimination of 1 million two-stroke motorcycles, the new purchase of 0.6 million electric (-assisted) bicycles, the new purchase of 2,858 electric buses to replace diesel-powered buses, and the new purchase of 2,100 electric produce transporters for produce markets.

Keywords: Promotion, Subsidy, Scooter, Bus, Tricycle

1 Introduction

The EPA has been active in popularizing “the low-carbon Sustainable Homeland promotion plan” ; with regard to green transportation, low-emission and energy-saving vehicles and intelligent transportation have been introduced to build a safer, more comfortable and environmentally friendly sustainable traffic system in order to achieve the objective of reducing carbon emissions. According to statistics, Taiwan had more than 21.40 million mobile vehicles, with the majority, about 13.66 million of them being motorcycles, as of the end of December 2015. Because of the high population density in metropolitan areas, gases exhausted from vehicles have aggravated air pollutions of such areas. In order to reduce the air pollutions caused by vehicles, the control of mobile pollution sources has become an important work of the EPA, which implements such control measures as new vehicles and in-use vehicles control, clean fuels and low-pollution vehicles promotion, and traffic control. The details regarding the measures for mobile pollution source control are listed in table 1[1]. The EPA has taken actions to improve air quality by reducing gas emission from sources, investing a total of NT\$39.2 billion in the “Clean Air Action Plan” from 2015 to 2020[2]. The plan is expected to reduce the average PM_{2.5} concentration from 23.5µg/m³ in 2014 to 15µg/m³ in 2020. Some of the targets for low-pollution vehicle promotion by subsidization include the elimination of 1 million two-stroke motorcycles, the new purchase of 0.6 million electric (-assisted) bicycles, the new purchase of 2,858 electric buses to replace diesel-powered buses, and the new purchase of 2,100 electric produce transporters for produce markets[2].

Table 1: Measures for mobile pollution source control

Measures	Items
1. New vehicles control	– Stricter emission standards by phases. – Examinations of new vehicle model and new vehicle tests.
2. in-use Vehicles	– Regular inspections of motorcycle emissions.

control	– Non-scheduled inspection of diesel vehicles. – Encourage the reporting of “black-smoke vehicles”. – Speed up elimination of old two-stroke motorcycles. – Promote the integration of insurance and inspection for gasoline vehicles in use. – Promote a maintenance system for diesel vehicles in use.
3. Clean fuels promotion	– Motor gasoline and diesel control standards. – Impose Fees for air pollution caused by vehicle emissions. – Prohibit illegal oils. – Promote an Increase of oil-gas dual-fuel vehicles and gas stations. – Subsidize the price of liquefied petroleum gas.
4. Low-pollution vehicles promotion	– Promote electric scooters, cars and buses. – Promote to the building of battery swapping operation systems. – Subsidize the purchase of electric-assisted bicycles and electric bicycles.
5. Traffic management measures	– Encourage the public to travel by public transportation systems. – Eco-driving. – Promote stop and go driving for vehicles.

2 Two-wheel electric vehicle promotion

2.1 Electric scooter

The number of motorcycles in Taiwan increases every year. According to statistics, Taiwan had about 13.66 million motorcycles as of the end of December 2015, making up 63.8% of the country’s total amount of mobile vehicles. For every one hundred people, there are 91.1 motorcycles, which is 1.11 times higher than the 81.8 in 2003. In general, the population density in domestic metropolises is mostly greater than 20,000 people per square kilometre, so motorcycle emission reduction has now become one of the most predominant issues with regard to air pollution improvement in these areas.

Since 2009, the government has announced subsidy policies for electric scooter (ES) equipped with lithium batteries and also issued the Taiwan E-Scooter Standard (TES) that is used for testing ES performance and safety. As of 2015, 18 ES models have been approved with TES tests, including 3 small-light types, 13 light types and 2 heavy types. The Industrial Development Bureau (IDB) of the Ministry of Economic Affairs (MOEA) and the EPA cooperate to subsidize people to purchase TES-verified ESs. Furthermore, additional subsidies are offered to Taiwan’s offshore areas. In July 2015, the EPA began to increase subsidy to people who purchase new ESs and eliminate two-stroke motorcycles. Meanwhile, various amounts of additional subsidies are offered by local governments, as described in table 2. From November 2009 to February 2016, a total of 41437 TES-verified ESs were sold with subsidy, with 11087 ESs being sold in 2015 and 2275 ESs already in January and February 2016[3]. The additional subsidy provided by the EPA has increased ES sales.

Table 2: Governmental subsidies for electric scooters

Apply for	Subsidy by IDB		Subsidy by EPA		Subsidy by local governments	
	Heavy/Light	Small-Light	Heavy	Light/ Small Light	Heavy	Light/ Small Light
Eliminating a two-stroke motorcycle and purchasing a new one	10000(1) (offshore additional subsidy 18000)	7200 (offshore additional subsidy 8000)	7000	5000	2100~17000 (2)	1500~17000 (2)
Purchasing a new ES	10000 (additional offshore subsidy 18000)	7200 (additional offshore subsidy 8000)	4000	2000	1200~12000 (2)	600~12000 (2)
(1) NT dollars.						
(2) Various subsidy amount is offered by each local government.						

2.2 Battery swapping station for electric scooters

The cruise range of ES is inferior compared with motorcycle and it takes roughly 2-4 hours to charge the battery. The quick battery swapping and electric energy supplement for ES is the key to popularizing it. Regarding the ES promotion policy, the EPA has emphasized both the battery swapping system and the battery-swappable ES. The EPA has begun not only stipulating common specifications for swapping batteries for ES but also creating a desirable environment of battery swapping for ESs by establishing more battery swapping systems and billing systems, which can solve such issues as the high cost of ES batteries and the inconvenience of battery charging.

On June 14, 2011, the EPA published the “Regulations for Subsidizing Battery Swapping Systems of Electric Scooters”. In accordance with the regulations, the subsidies were approved for City Power company in New Taipei City and Kentfa company in Kaohsiung City to build 30 battery swapping stations with NT\$45M each, and battery exchange fee subsidies of up to NT\$10,000 are given to the first five thousand members of each system.

In order to make all the battery swapping systems compatible, the EPA launched the specifications of common batteries that were jointly stipulated by vehicle, battery and connector manufacturers, and the common battery can be used in both ESs and electric (-assisted) bicycles for battery swapping applications. On December 19, 2013, the EPA issued the “Verification Specifications of Common Batteries for Battery Swapping System of Two-wheel Electric Vehicle” and the “Subsidy Regulations for Two-wheel electric Vehicles Retrofitted with Common Batteries”, with a subsidy of NT\$0.65M offered for each applicable electric bicycle manufacturer and NT\$1.0M for each applicable ES manufacturer. This encourages common batteries to be adopted by two-wheel electric vehicles and thus spreads the battery swapping systems. By July 2015, six models of common battery, produced by four different battery manufacturers, and nine models of electric bicycles equipped with common batteries, produced by seven different manufacturers, had become available for sale. On January 3, 2014, the “Regulations of Subsidization for the Purchase of New Electric Bicycles with Common Battery” were published and provide a subsidy of NT\$6000 for each vehicle to encourage consumers to buy electric bicycles equipped with common batteries. In the future, people can quickly refuel electric energy to two-wheel electric vehicles with widespread battery swapping systems that use common batteries, effectively providing solutions for the short cruise range of two-wheel electric vehicles.

As of August 2014, City Power Company had built 30 battery swapping stations in New Taipei City with 105 two-wheel electric vehicles, and Kentfa Company had built another 30 battery swapping stations with 443 two-wheel electric vehicles in Kaohsiung City for pilot demonstration. Most battery swapping stations were installed beside electric scooter stores or at main traffic arteries. Figure 1 shows the four models of common battery, Figure 2 shows six locations of the battery swapping station installed in New Taipei City and Figure 3 shows the battery swapping procedure at a station [4].



Figure 1: Four models of common battery



Figure 2: Six locations of the battery swapping station installed in New Taipei City.



Figure 3: The battery swapping procedure at a station

2.3 Electric bicycle

The production of two-stroke motorcycles in Taiwan was banned in 2004 because the average air pollutant (HC) exhausted by a two-stroke motorcycle is around 18 times of that exhausted by a four-stroke motorcycle. However, as of the end of December 2015, more than 2.16 million two-stroke motorcycles were still in service, including 1.85 million light ones, whose cylinder displacement is less than 50cc. light motorcycles are mostly used for short-distance riding around the vicinity, and the exhausted gas has a direct impact on human health. Therefore, more and more people are tending to buy low-pollution vehicles such as electric (or electric-assisted) bicycles. In order to encourage people to use low-carbon vehicles, the EPA started to subsidize people buying electric-assisted bicycles in 2001 and those buying electric bicycles in 2009. Since July 20, 2015, additional subsidies have been provided to eliminate two-stroke motorcycles and buy new electric (-assisted) bicycles, as shown in table 3[1]. As of December 2015, a total of 772,873 two-stroke motorcycles have been subsidized and eliminated. Meanwhile, 82,973 electric-assisted bicycles

and 125,180 electric bicycles have benefitted from the subsidies. According to the EPA's "Clean Air Action Plan" announcement on Sept. 2, 2015, between 2015 to 2020, 1 million two-stroke motorcycles must still be eliminated and 0.6 million electric bicycles are to be purchased by subsidy, with a total subsidy of NT\$2.904 billion.

Table 3: Subsidies for eliminating two-stroke motorcycles and buying new electric bicycles

subsidy period	Applied condition	Amount of subsidy (NT\$)
2015	eliminating a two-stroke motorcycle and buying a new one	6000
	buying a new electric bicycle	3000
	eliminating a two-stroke motorcycle	1500
2016	eliminating a two-stroke motorcycle and buying a new one	5000
	buying a new electric bicycle	2000
	eliminating a two-stroke motorcycle	1500

3 Electric bus promotion

Gases exhausted from the diesel-powered urban buses and general highway public transport buses for public transportation are related to the increasing risk of lung cancer and are listed as type-I carcinogen of the highest risk by the WHO's IARC. Electric buses used for public transportation has now become the main subject of government policies for developing electric vehicles because of the significant emission reduction and fewer problems related to arranging and building the charging stations for electric buses with fixed public bus routes. The Intelligent Electric Vehicle Industry Development Strategy and Action Plan, launched by the Government in 2014[5], emphasized replacing 10,000 urban buses and general highway transport buses with electric buses during the ten-year interval from 2014 to 2023. The promotion campaign is implemented by the Ministry of Transportation and Communications (MOTC), the EPA and the MOEA, and the following promotion policies were determined:

- Increase the subsidy of each electric bus to replace old buses to make the purchase cost equivalent to that of a diesel bus.
- Build charging stations and battery swapping stations to facilitate charging and battery swapping for electric buses.
- Improve the performance of electric buses, including battery quality and efficiency, in order to meet the requirements of public transportation.

The promotion of electric buses is primarily dominated by the MOTC. According to The Guideline of the Highway Public Transportation Subsidy for Electric Buses, public transport system operators could receive a subsidy of up to NT\$5.25M for the purchase of each electric bus, of which NT\$3.75M is provided by the MOTC and NT\$1.5 M by the EPA. Furthermore, the EPA is working with the MOEA on the Intelligent Electric Vehicles pilot demonstration plan, mainly for electric buses pilot run with non-fixed routes, to subsidize the operators with vehicle depreciation and hardware and software facilities up to 49% of the operational expenses. For this purpose, the EPA has provided a fund of NT\$300M to subsidize the construction of battery swapping stations for electric buses. At the same time, electric buses must comply with MOTC's "Vehicle Safety Inspection Regulations" to obtain the necessary certifications of vehicle type and safety inspection in order to be eligible for the subsidies. The governmental subsidies for promoting electric buses are listed in table 4, and inspection items for electric bus performance and safety are shown in Table 5. As of September 2015, Taiwan had 143 electric buses operating. According to the EPA's "Clean Air Action Plan", a total of 2,858 electric buses will be promoted from 2015 to 2020 with a subsidy of NT\$11.207 billion.

Table 4: Governmental subsidies for promoting electric buses

Subsidy items	Subsidized by:	Amount of subsidy
Electric buses running on fixed routes	MOTC	– Replacement with large new one for existed fixed routes, and each bus is subsidized with 49% of the price of the bus body (not including the battery), up to a limit of NT\$2.672M. – Replacement with middle new one for existed fixed routes, and each bus is subsidized with 49% of the price of the bus body (not including the battery), up to a limit of NT\$2.5M. – A new one for new fixed routes, and each bus is subsidized with 80% of the price of the bus body (not including the battery), up to a limit of NT\$3.75M.
	EPA	A maximum subsidy of NT\$0.5 M to each bus body and NT\$1.0 M to each battery pack of bus.
Battery swapping station for electric buses running on fixed routes	EPA	The subsidy amount is provided according to the number of electric buses that swap batteries at the station. The maximum subsidy is NT\$1.2M per bus, with the upper limit being less than 50% of the total cost of building the station.
Electric buses running on non-fixed routes on the Intelligent Electric Vehicles pilot demonstration plan	EPA/MOEA	The subsidy is provided for electric buses that have road licenses and software and hardware facilities of operation, with an upper limit of 50% of the total budget approved in the Plan.
	EPA	Subsidy amount of NT\$300M for electric bus battery swapping stations and relevant infrastructures.

Table 5: Inspection items for electric bus performance and safety

Items	Contents
Vehicle Safety	– Vehicle slope stability tests – Dynamic brakes – Static brakes – Structural strength of bus body – Fire prevention regulations
Vehicle Performance	– Climbing durability – Battery charge/discharge cycles tests – Charger actuation durability and push-out force of connection tests – Wiring load and electric leakage tests – Cruise mileage test of battery
Usability	– Electromagnetic interference/ anti-interference – Manipulability – Battery capacity use limitations – Vehicle allocation due to battery charging or swapping – Logistic maintenance

4 Electric produce transporter promotion

Xiluo produce Market is the largest wholesale market which supplies one-third fruit and vegetable demand in Taiwan. However, each day more than 800 diesel-powered tricycles running all around the market result in serious air and noise pollution. In 2010, the EPA launched a program to promote electric produce transporters and commissioned the Industrial Technology Research Institute for the pilot operation and evaluation of electric trucks. In 2013, it facilitated domestic vendors to develop a retrofitting scheme for the electrification of diesel-powered tricycles, as shown in Figure 4 for the vehicle-wide system architecture of the three-wheel electric truck, and concerns about cost, manipulation, turning radius and insufficient brake force expressed by dealers were all solved. On July 3rd, 2013, the EPA published the "Regulations Covering Subsidies for Electric Produce Transporters in Xiluo Produce Market". According to the regulations, the EPA's subsidy covers the purchase cost for electric trucks (excluding batteries) and the rental fee for power batteries. Furthermore, the Yunlin County Government provides an additional

subsidy to the new purchase of electric truck. It is a total subsidy of NT\$200,000 for the purchase of a new electric truck and NT\$140,000 for retrofitting a used diesel tricycle into a three-wheel electric truck, as well as NT\$3500 per month for battery rental for 5 years. At the same time, a battery management operator was also established and subsidized in order to provide battery rental and maintenance services. To ensure the performance and safety of electric trucks, the "Verification Specifications of Electric Produce Transporter in Xiluo Produce Market" has been stipulated, and a certification mechanism has also been established to ensure that only the purchase of a certified electric truck is eligible for the subsidy. As of December 2015, two retrofitting factories of three-wheel electric truck had been established in the vicinity of Xiluo produce Market and 56 diesel tricycles had been retrofitted into three-wheel electric truck with lead-acid cells as their power source. Figure 5 shows the appearance of a retrofitted three-wheel electric truck. The goal is to eliminate 500 diesel tricycles from Xiluo produce Market by 2018 to improve the air quality to comply with the indoor air quality standards in Taiwan [6].

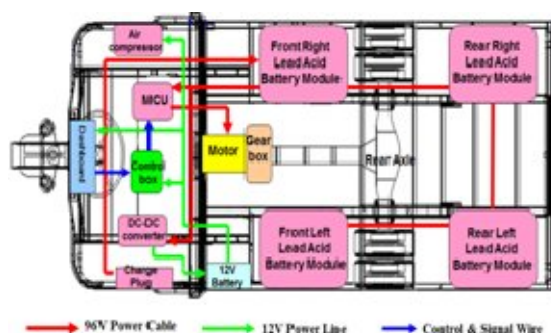


Figure 4: vehicle-wide system architecture of the three-wheel electric truck



Figure 5: The appearance of a retrofitted three-wheel electric truck

The EPA has expanded the achievements of electric produce transporters in Xiluo produce Market to promote electric produce transporters equipped with lithium batteries, which reduces the potential risk of secondary pollution of lead-acid batteries and substantially decrease the volume of battery pack, and makes it more suitable for the application demands of electric produce transporters with various sizes and models. By 2020, It is planned that 1600 electric produce transporters with lithium batteries will be subsidized for the new purchase in 14 produce wholesale markets over the country with 49% of the purchase cost and up to a upper limit of NT\$200,000 per vehicle. Furthermore, the "Verification Regulations of Lithium Battery for Electric produce Transporter" and the "Verification Regulations for Electric Produce Transporters" are stipulated for safety validation of both lithium battery and the whole vehicle, and only the verified lithium batteries and electric produce transporters are eligible for the subsidy. The "Clean Air Action Plan" launched by the EPA plans to provide NT\$457.5M of subsidy from 2015 to 2020 for the promotion of electric produce transporters.

5 Conclusion

"The Air Pollution Prevention Regulations" stipulated by the EPA in 1975 have promoted air pollution control measures regarding pollution source for 40 years, while most recently, the $PM_{2.5}$ pollutant has been determined as the key control point. The "Clean Air Action Plan (2015~2020)" published in September 2015, set a goal to reduce the pollutant to less than $15\mu g/m^3$ for the country-wide annual average. The plan proposes the enhancement measures of short term by raising the amount of subsidy in order to facilitate citizens and operators to use two-wheel electric vehicles and electric buses, as well as to eliminate high pollution two-stroke motorcycles. Furthermore, the plan assists Xiluo produce market in creating the three-wheel electric truck retrofitting scheme and establishing battery management operator, and the subsidy is offered for the vehicle and battery, respectively. Regarding the electric produce transporters, the verification regulations for lithium batteries and entire vehicle were stipulated, and vendors were assisted in obtaining the certification of both the lithium battery and the entire vehicle. It is planned to promote the full utilization of electric produce transporters equipped with lithium batteries in Taiwan's produce markets.

Taiwan has the highest density of motorcycle in the world and the cleaner hydrogen fuel cell electric scooters have a superior condition for promotion, but the much higher cost than a regular electric scooter and the lack of hydrogen fuelling stations have been the biggest obstacles to public acceptance. The government is expected to gather resources and starts the trend of fuel cells, so that more vendors will be dedicated to the exploitation of fuel cell electric scooters, as well as fuel cell refuelling equipment, which will help Taiwan to develop hydrogen economics.

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