



Environmental Policy Quarterly

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Waste

Zero Waste via Circular Economy and Recycling

Under the circular economy principle focusing on at-source reduction and recycling, Taiwan has reached an industrial waste recycling rate of 80% and a garbage recycling rate of over 60%. Having Set recycling and sustainable use of resources as main future policies, the EPA has been pushing for garbage reduction, recycling, and reuse. Furthermore, garbage disposal policies of greater environmental and economic benefits are planned for implementation, aiming to accomplish the goals of resource integration and zero waste.

Background

In December 2003, the Executive Yuan passed the *Evaluation and Outlook for Garbage Disposal Plans* (垃圾處理方案之檢討與展望). Since then various efforts have been taken concerning zero waste, mandatory garbage sorting, diverse reuse of kitchen wastes, large-sized waste items, waste from renovations, manure mixed with night-soil treatment facility installations, and replacement of obsolete garbage clearance and transport equipment.

As the *Mandatory Garbage Sorting*

Plan (垃圾強制分類計畫) is carried out in stages, great progress is evident in recycling and reuse statistics. Taiwan's average daily garbage clearance per capita has gradually fallen since 1998, and by 2017 it was less than the previous highest average of 64.75%. The amount of resources found within garbage has decreased as well, and the waste recycling rate reached 60.22% in 2017.

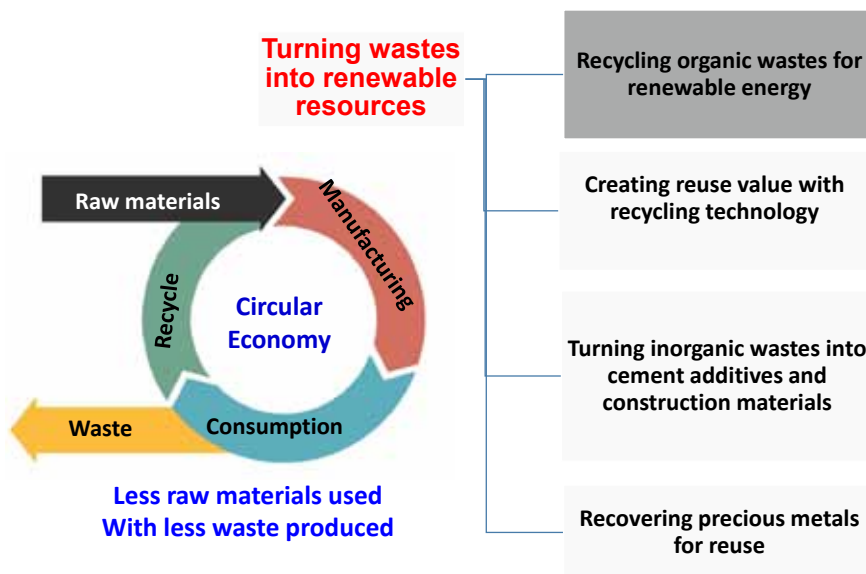
Over 60% resources recycled via proper sorting

The *Four-in-One Resource Recycling Plan* (資源回收四合一計

畫), in effect since 1997, targets waste recycling and reduction by coordinating community members, recyclers, local governments, and recycling funds, as well as encouraging public participation. Recycling organizations established voluntarily by citizens and communities properly sort through discarded materials and household-produced garbage, which are separated and collected at recycling spots by local cleaning teams or private recyclers. Moreover, local cleaning teams and recyclers are subsidized with the recycling fund to establish a

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⬆ Setting recycling and sustainable use of resources as main future policies, the EPA has been pushing for garbage reduction, recycling, and reuse.

comprehensive resource recycling system, so materials can be effectively recycled and reused.

Mandatory garbage sorting began in 2005. Household trash is required to be divided into three categories--as resources, kitchen waste, and garbage--and then separately collected or disposed of by cleaning teams. Per-bag trash collection fees, implemented in certain counties, cities, or districts, also contribute to improved trash reduction, sorting, recycling, and reuse. After the *Environmental Education Act* (環境教育法) was promulgated, environmental education has become more in-depth to help the public become more knowledgeable of environmental protection principles in their daily lives.

Reuse of industrial waste

The EPA amended the *Waste Disposal Act* (廢棄物清理法) on 24 October 2001 to promote proper industrial waste management and reuse. Article 39 mandates that industrial waste reuse is to

be implemented as required by the central competent authorities. Since then, 10 agencies have respectively formulated regulations and management systems relevant to industrial waste reuse specific to industries under their jurisdictions. They include the Ministry of Economic Affairs (MOEA), the Ministry of Science and Technology (MOST), the Council of Agriculture (COA), the Ministry of Health and Welfare (MOHW), the Ministry of the Interior (MOI), the Ministry of Transportation and Communications (MOTC), the Ministry of Education (MOE), the Ministry of Finance (MOF), the National Communications Commission (NCC), and the EPA.

Through joint efforts of various central competent authorities, 80% of industrial waste is reused. This indicates that regulatory revisions have effectively led to the reuse of Taiwan's waste and resource materials in order to reach the goal of zero waste.

According to each central competent authorities' regulations, industrial waste can be reused in the factories or plants which produce it, in accordance with announcements and tables in the regulations, and as otherwise permitted.

(1) Reuse in originating factories (plants): For enterprises listed under Article 31 Paragraph 1 of the *Waste Disposal Act*, waste can be reused in the factories (plants) where it is produced. Industrial waste disposal proposals are required to be evaluated and approved by the municipal, county, or city authorities or agencies commissioned by the central authorities. Enterprises not listed may reuse industrial waste inside the originating factories (plants) without approval.

(2) Reuse according to announcements/tables listed in regulations: For industrial wastes of a stable nature, or that involve mature reuse technology, enterprises and reuse agencies can process the waste according to the categories and management methods announced or promulgated by the central competent authorities.

(3) Reuse as permitted: For categories and management methods not under the aforementioned announcements/tables, industrial waste can be sent to reuse agencies for reuse only with permission from the central competent authorities.

There are a total of 104 categories of industrial waste listed in announcements and tables, as well as roughly 1,400 agencies

that reuse industrial waste. In 2004, the industrial waste that was reported totalled 1,887 tons. The majority went to reuse, comprising 1,520 tons, or 80% of registered industrial waste.

Recently, large amounts of registered reutilized products were found to have been dumped or misused, creating potential environmental risks. As a result, the EPA required environmental authorities to re-examine the specifications for certain products, which are used for evaluating proposed plans for industrial waste disposal. In addition, communication and coordination between industrial and commercial registrants need to be strengthened. The competent authorities relevant to each industry are to impose penalties based on pertinent regulations, should incidents such as product

dumping, illegal usage, or other environmental problems occur.

Aiming to enhance the effectiveness of management in response to changes in the economy and overall industrial structure in the last decade, the EPA began reviewing industrial waste reuse conditions in 2003. Future control strategies were also formulated with short-, mid-, and long-term projects in order to increase the responsibilities of resource reuse entities, expand responsibilities and self-regulation of production sources, and enhance control over the flow of reuse products.

(1) Short-term projects

Speeding up legislation of the *Resource Recycling and Reuse Act (draft)* (資源循環利用法)

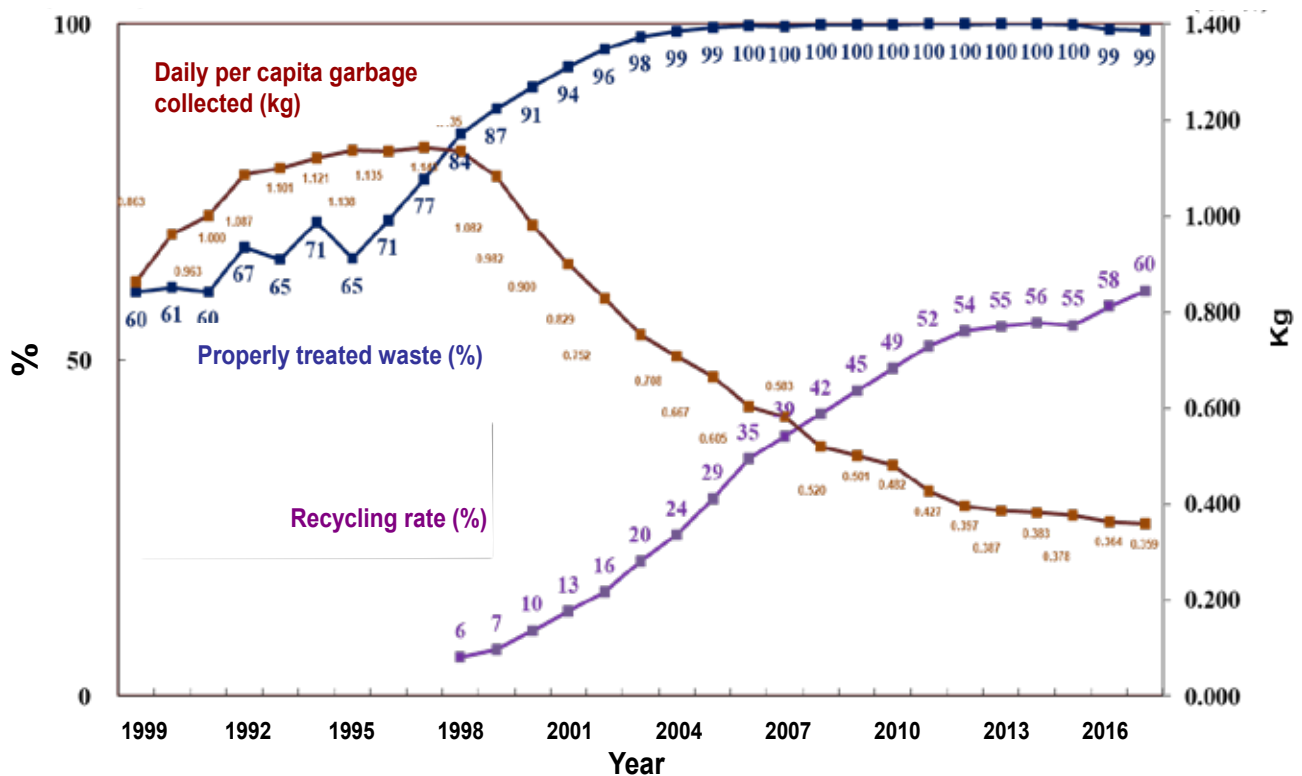
Formulating, establishing, and maintaining the reuse product reporting system that integrates and utilizes administrative resources

Conducting special investigations firstly on products from reused materials, including management risks, and also increasing frequency of audits

(2) Mid-term projects

Setting up management regulations for industrial waste reuse agencies, reuse categories and control methods, permits and control mechanisms for reuse agencies, and other complementary measures, all in response to the implementation of the *Resource Recycling and Reuse Act*

Continuing to conduct special



Taiwan's waste recycling rate reached 60.22% in 2017.

investigations on reuse products considered high-risk, making audit plans for specific industrial wastes, and increasing the scope of controlled enterprises

(3) Long-term projects

Reviewing implementation conditions for the *Resource Recycling and Reuse Act*, and continuing to evaluate and improve auditing mechanisms for reuse agencies and various

complementary measures

Setting up an integrated resource management system, and holding regular audits on reuse agencies

For information on reuse agencies, please visit the Resource Management System at <http://rms.epa.gov.tw>.

Future outlook

The EPA stressed that Taiwan's garbage clearance policies

will continue to focus on at-source reduction and recycling in line with the trends of resource sustainability and zero waste. Green production and consumption, at-source reduction, and resource recycling, reuse, and reutilization will continue to be promoted to effectively recycle and utilize resources, gradually achieving the goals of total recycling and zero waste.

Water

Taiwan's Marine Pollution Prevention and Control

As an island located amidst major shipping lanes in the western Pacific, Taiwan sets great store by marine pollution prevention. The EPA utilizes the latest technology to monitor and respond to marine pollution in times of emergency to protect ocean water quality. Ocean waste management is becoming increasingly important as the overall environmental quality deteriorates, thus the central and local governments along with grassroot organizations are joining together to clean up waste, aiming to jointly work towards a plastic-free marine environment and preserve the marine ecosystem.

Analysis from the International Maritime Organization (IMO) shows that 44% of marine pollution comes from the land, 33% from atmospheric transmission, 12% from vessels, 10% from ocean dumping, and 1% from ocean construction. The EPA has been conducting marine pollution prevention and control by planning, guiding, supervising, and implementing various strategies and measures. Furthermore, the *Marine Pollution Control Act* (海洋污染防治法) was formulated based on the international Convention on the Law of the Sea, and announced on 1 November 2000. The Act was then revised on 4 June 2014. The authorities responsible for its implementation are the EPA in the central government and city/county/municipal governments

at local levels. The Coast Guard is in charge of cracking down on illegal activities, collecting relevant evidence, and referring the violations.

Marine pollution control via monitoring and law enforcement

The EPA strives to increase the effectiveness of emergency response measures against major oil pollution incidents in the marine environment. Based on the *Major Marine Pollution Incident Emergency Response Plan* (重大海洋油污染緊急應變計畫) approved by the Executive Yuan, responses fall into three main categories as follows:

A. Scientifically monitoring marine pollution

To protect the marine environment, the EPA has been promoting pollution controls as well as strengthening the legal framework. Various technologies are skillfully used to effectively monitor all types of pollution sources to help reduce pollution at its sources and to inspect for illegal activities. These technologies include remote satellite sensing, unmanned aerial systems (UAS), oil spill-detecting radar monitoring vehicles, and oil and chemical pollution dispersion simulation models.

B. Response to marine pollution incidents

The EPA regularly enhances its response capacities to oil pollution incidents by better utilizing technology, integrating resources via information systems, and



📍 An unmanned aerial system monitors an oil spill where the TS Taipei ran aground in 2016.

advising local governments on being better equipped and prepared. Once a pollution incident occurs, the EPA supervises and coordinates responsible central and local authorities under the *Major Marine Pollution Incident Emergency Response Plan*. This ensures that response measures are thoroughly carried out at all levels and emergencies are properly handled.

The characteristics and quantities of the oil need to be taken into account during an oil spill incident in the ocean. The spill location, the surrounding marine environment, and oceanic and meteorological conditions must be considered to evaluate the scales of potentially impacted areas and further determine how the marine environment and ecosystem may be affected.

C. Marine waste cleanup and plastic-free ocean campaign

Marine waste mostly comes from solid waste disposed on land and coastal areas that greatly affects the seabed ecosystem. Thus, the EPA formulated the *Floating Trash Disposal Program* (海漂垃圾處理方案) to implement at-source controls of marine waste and to organize beach and ocean cleanups.

The research conducted by the Society of Wilderness on the components of ocean waste in 2015 showed that plastic waste comprises 90% of it. To reduce plastic waste in the oceans, in 2016 the EPA tightened relevant policies by limiting and reducing the use of plastics at their sources. On 13 February 2018, the *Action Plan of Marine Debris Governance in Taiwan* (臺灣海洋廢棄物治理行動方案) was announced by the EPA, accompanied by representatives from NGOs concerned about marine environmental preservation, the National Museum of Marine Science & Technology, and others from

academia. The details include a total ban by 2030 on single-use plastics, such as shopping bags, utensils, beverage containers, and straws. The action program is also working on banning plastic straws starting in 2019 to make Taiwan the first country to limit the use of plastic straws.

Central and local governments mobilized to clean up oceans

Cleanups of garbage on the ocean floor are carried out by divers, while waste on beaches is regularly cleaned up by local governments under the EPA's supervision. In 2016, Taitung County, Kinmen County, Pingtung County, and Lienchiang County received subsidies to conduct marine waste cleanup projects. This resulted in more than 400 metric tons of garbage from the ocean floor and beaches being collected, including 480 metric tons of recyclable materials. In addition, 25 sessions on marine



← Taiwan's Marine Debris Governance Platform.

environmental education were held. The EPA hopes that with the combined efforts and resources of governments and the public, the marine environment and resources will be better protected.

The EPA continued to subsidize local governments to carry out marine waste cleanup projects in 2017. Nineteen coastal counties and cities were mobilized to organize a nationwide event on World Oceans Day on 8 June, which included waste cleanups and marine environmental education. An environmental fleet has been assembled as well. To deal with random dumping, vessels such as fishing boats, yachts, whale-watching boats,

ferries, as well as the public, fishermen, and boat owners are encouraged to bring back and properly dispose of waste produced during sightseeing, leisure, and fishing activities.

As part of improving the coastal and marine environments of offshore islands, the EPA also provides subsidies for relevant projects to Kinmen and Lienchiang Counties, as floating waste originating from China affects these islands. The subsidies assist them to better carry out coastal environmental maintenance, floating and bottom trash cleanups, waste transfers and recycling.

Future plans

Taiwan is located in the midst of many international shipping lanes, with thousands of containers and vessels sailing through its waters every day. In response to this, the EPA will keep on strengthening marine pollution control measures and monitoring the marine environment according to the *Marine Pollution Control Act*. While monitoring pollution sources with the latest technology, the EPA will also actively promote the pollution emergency response mechanism and increase the effectiveness of control measures. Other efforts will include continuous marine waste cleanups and at-source waste reduction to protect the marine environment.

Air

Mandatory Installation of Air Pollution Control Equipment for Restaurants Considered

The air pollutants produced in the cooking process by the food and beverage industry can have a significant effect on regional air quality. Hence, the EPA plans to formulate the *Management Regulations Governing Air Pollution Control Equipment for the Food and Beverage Industry*. To improve air quality, the regulations stipulate that enterprises that have reached a certain scale are required to install cooking fume extractors, exhaust pipes, air pollution control equipment, and vents.

There are about 100,000 registered food and beverage businesses in Taiwan, among which approximately 70% are in densely populated residential and residential-commercial mixed zones in Taipei City, New Taipei City, Taoyuan City, Taichung City, Tainan City, and Kaohsiung City. According to statistics from the Taiwan Emission Data System (TEDS 9.0), the amount of air pollutants emitted by the food and beverage industry account for approximately 6.24% of the national total emissions, while the electricity industry accounts for about 3.85%.

Clearly, the air pollutants created from food preparation processes have significant impacts on regional air quality and can easily cause inconvenience to local residents.

To reinforce the control of air pollutants produced by the food and beverage industry and to reduce public dissatisfaction, the EPA has drawn up the *Management Regulations Governing Air Pollution Control Equipment for the Food and Beverage Industry* (hereinafter referred to as the Regulations) based on the *Air Pollution Control Act*. The Regulations apply to any enterprises either with capital over NT\$100,000 and a store space more than 100 m², or with a record of receiving more than three complaints within 30 days.

The above mentioned enterprises are required to install cooking fume extractors, exhaust pipes, air pollution control equipment, and vents. Additionally, the enterprises will also need to document all the related information regularly for

future reference and investigation.

The EPA estimates it will regulate roughly 40,000 enterprises in the food and beverage industry that possess a capital value over NT\$100,000 and a store space over 100 m². The EPA decided to also include businesses of a smaller scale or with less capital because their locations are often close to residential areas and they can greatly affect the local environment and quality of life. Therefore, any such small-scale businesses that have received more than three complaints from neighboring residents within 30 days will be subject to the Regulations. After the Regulations take effect, the EPA estimates at least 1,000 small-scale businesses will be under these controls.

Waste

Restrictions on Plastic Straws Preannounced

Due to the growing urgency to address marine plastic pollution, the EPA has drafted the *Restrictions on Single-Use Plastic Straws*. Management experiences from the US, the UK and other countries were referred to, and the restrictions will start by prohibiting four types of businesses from providing plastic straws to any dine-in customers. The EPA will also give adequate grace periods to the control targets.

After plastic straws are used, they are discarded in the environment where they break down into small plastic pieces or are ingested by animals. The ingested plastic can absorb toxins in the environment, and then accumulate and be consumed by animals higher up in the food chain. The draft stipulates that the following four categories of businesses (roughly 8,000 businesses in total) will be prohibited to provide single-use straws for customers dining in-

store: public sector entities, public and private schools, department stores, and shopping malls.

The EPA plans to expand the control targets to include other kinds of businesses in the food and beverage industry by 2020. Furthermore, the EPA also aims to formulate control measures for take-out customers by 2025 at the latest. However, the EPA urges businesses to take early action by not providing plastic

straws unless customers request them. The general public is also encouraged to prepare their own reusable straws to reduce plastic pollution and waste of resources. In addition, the plastic straws attached to drinks in Tetra Pak packaging are also being considered to be put on the control list. The evaluation will be carefully made after considering past experiences from other countries and gathering of public opinion.

Air

Subsidies for Switching to Cleaner-Fuel Boilers Expanded

On 4 May 2018, the EPA announced the amendments to the *Regulations Governing Subsidies for Modification or Replacement of Boilers* (改造或汰換鍋爐補助辦法). The purpose of the amendments is to accelerate the process of switching boiler fuels to cleaner alternatives and to reduce the air pollutant emissions produced. The major points of the amendments are to expand the subsidized targets and to extend the application period to 30 June 2019.

Starting on 15 April 2017, the EPA began providing hotels, medical and health care institutions, social welfare organizations and schools with subsidies to modify or replace their oil-fired boilers with heating equipment that uses low-emission gases, solar energy or electricity.

The EPA decided to amend the regulations to further expand the enterprises eligible for the subsidy. The amendments stipulate that any private or public premises that have modified or replaced their boilers after 15 April 2017, and are now using or in the process of establishing heating equipment powered by low-

emission gases, solar energy or electricity, qualify for the subsidy. A subsidy can be provided for each boiler, up to a maximum of NT\$500,000. However, the regulations do not apply to the following: factories governed by the *Factory Management Act*, electricity enterprises governed by the *Electricity Act*, and state-owned enterprises governed by the *Administrative Law of State-Owned Enterprises*. To provide sufficient time for the conversion, the application period for the subsidy is extended to 30 June 2019.

The EPA also points out that the

draft of the *Boiler Air Pollutant Emission Standards* (鍋爐空氣污染物排放標準) was preannounced on 30 January 2018, and is now undergoing the legislative procedures of discussions and public hearings. It is targeted that all boilers – regardless of fuel types or operation scale – shall meet the emission standards by 1 July 2020. Through administrative control and economic incentives, the EPA aims to diminish boiler air pollutant emissions and their impacts on air quality, as well as the number of air pollution red alert days.

Air

Phasing Out Old Vehicles with Subsidies and Tighter Controls

The draft of the amendments to the *Air Pollution Control Act* (空氣污染防治法) is currently under review in the Legislative Yuan. The amendments will tighten emission standards for vehicles that were manufactured more than ten years ago and designate air quality control zones that forbid or limit specified vehicles from entering. It is hoped the phase-out of highly polluting old vehicles will be expedited through subsidies and tightened controls. The ultimate goal is to eliminate all two-stroke motorcycles and heavy-duty diesel vehicles targeted in the first and second phases of the vehicle emission standards.

The EPA stated that according to statistics, mobile pollution sources account for 30~37% of Taiwan's PM_{2.5} emissions. Among that, 2~2.6% of emissions come from two-stroke motorcycles, and 11.2~16.8% from heavy-

duty diesel trucks, showing the need to speed up the phase-out of said vehicles. Starting in 2008, the EPA has been offering subsidies for phasing out two-stroke motorcycles. From 2010, the EPA has further subsidized the

purchase of electric motorcycles. In addition, the governments of Taipei City, Taoyuan City, Taichung City, Kaohsiung City, Yilan County and Nantou County provide additional subsidies of NT\$4000-30,000 to mid- and low-income

households to replace two-stroke motorcycles with new electric ones.

In addition, since August 2017 the EPA has offered subsidies for phasing out heavy-duty diesel trucks subject to the first-and second-phase vehicle emission standards. Data shows that the phase-out of more than 1.32 million two-stroke motorcycles and more than 6,000 of the said diesel trucks has been subsidized as of the end of March 2018. A goal has been set to phase out all the two-stroke motorcycles and heavy-duty diesel trucks targeted by the

phase 1 and 2 vehicle emission standards by the end of 2019.

Besides the subsidies above, the Legislative Yuan has passed the preliminary review of the draft amendments to the *Air Pollution Control Act* formulated by the EPA. Article 36 in the revision authorizes the EPA to tighten the original emission standards for motor vehicles that were manufactured over ten years ago. Article 40 mandates that competent authorities at all levels may designate air pollution control zones for mobile source pollution control according to

local air quality and pollution characteristics.

Once the amendments are approved, the EPA estimates that they will affect 98,000 gasoline vehicles manufactured before 1991, as well as 530,000 diesel vehicles and more than 7 million motorcycles regulated by the phase 1-4 vehicle emission standards. Taking two-stroke motorcycles for instance, stricter emission standards for vehicles manufactured more than ten years ago would lead to an increase of failed tests for CO emissions, rising from 14% to 45%, and

Table: The number of vehicles affected by tightened emission standards and the amount of pollutants reduced

Types	Tightened inspection standards for in-use vehicles	Number of vehicles affected	Reduced emissions (metric tons/year)						
			TSP	PM ₁₀	PM _{2.5}	CO	THC	NMHC	NOx
Gasoline vehicles	Vehicles manufactured before 1991 to comply with the standards of the third phase	98,124	-	-	-	4,846	1,142	1,027	797
Diesel vehicles	The first stage: Vehicles specified in the first three phases to comply with the standards of the fourth phase	344,733	5,318	5,318	4,892	32,201	8,778	8,778	68,332
	The second stage: Vehicles specified in the first four phases to comply with the standards of the fifth phase	530,528	1,685	1,685	1,551	19,519	2,655	2,655	54,591
Motorcycles	Vehicles specified in the first four phases to comply with the standards of the fifth phase	7,013,654	-	-	-	14,211	10,475	9,482	89

an increase of failed tests for hydrocarbon emissions from 6.5% to 9.5%. Other than replacing two-stroke motorcycles faster, vehicle owners will also consequently be encouraged to properly maintain their vehicles in order to comply with the new standards. A two-year grace period will be in place before the new standards take effect.

The EPA pointed out that although competent authorities at all levels are authorized to designate air

quality zones to limit or ban the entrance of certain vehicles, the zone area and the targeted vehicles must be deemed necessary. The control zones will not cover the entire country, and a grace period of three to six months will be given to help the public adjust. Only vehicle models meeting the criteria would be allowed to enter once air quality zones are set.

Although the subsidy provides an incentive for phasing out old

vehicles, it is not mandatory. The EPA is considering amending related regulations to put old, highly polluting vehicles under control in order to hasten the phase-out of such vehicles. Owners are encouraged to get rid of their old vehicles soon, so as to not only be eligible to apply for a subsidy, but also to avoid the trouble of violating future emission standards and being limited from driving in certain areas.

Environmental Monitoring

Taiwan and Germany Work Together on Regional Atmospheric Pollutant Tracking

To better understand the potential impacts of air pollution from China on the air quality in Taiwan, in 2018 the EPA will be working with Germany and Academia Sinica to conduct regional atmospheric monitoring experiments. The experiments will be performed in central Taiwan using aircraft to track pollution plumes and to examine how the pollutants emitted by the Taichung Power Plant affect air quality in downwind areas. Through this cooperation, the EPA will be able to improve its capability of tracking and analyzing air pollution sources and gain knowledge about air pollution movements downwind.

In collaboration with Academia Sinica and a research team from the University of Bremen (UB) in Germany, the EPA will be monitoring air pollution in Taiwan and East Asia using research aircraft provided by the German Aerospace Centre (Deutsches Zentrum für Luft- und Raumfahrt; DLR), as part of the research project known as Effect of Megacities on the transport and transformation of pollutants on the Regional and Global scales (EMeRGe).

The effects of megacities on both regional air quality and climate change is considered a major topic in today's atmospheric research. Hence, the UB organized EMeRGe, a research project on

atmospheric physics and chemistry being executed with great precision. The aim is to investigate the transport and transformation of air pollutants from megacities and their impacts on atmospheric composition and air quality.

Taking this opportunity to collect and analyze scientific data, the EPA plans to set up a tracking system for plumes in central Taiwan to further explore the causes of air pollution. The EPA will also use ground-based tracers and unmanned aerial vehicles (UAVs) with sampling equipment for this project.

According to the plan, the Taichung Power Plant, Mailiao Power Plant, and downtown Taichung City

will be releasing three types of perfluorinated compound (PFC) tracers. Fixed-wing UAVs carrying PFC sampling equipment will cruise between Taichung and Nantou at an altitude of either 300 or 500 meters to take samples. In downwind areas, a total of 12 UAVs will be taking samples simultaneously in Taichung and Nantou from various altitudes: 100, 200, 300, 400, and 500 meters.

PM_{2.5} is currently the most highly discussed air pollutant in Taiwan for many reasons: its diverse sources, its complex chemical composition, and its transport that involves complicated physical and chemical reactions. Although experts and scholars in the field have spent years researching



📍 EPA Minister Ying-Yuan Lee (fourth from right) and Mayor of Taichung City Chia-Lung Lin (fourth from left) attend the press conference for the Taiwan-Germany cooperation on regional atmospheric monitoring.

PM_{2.5}, many questions still remain. Tracking the plumes of polluted air is fundamental to clarifying the sources of the pollution. By releasing tracers in

the environment, the air quality impacts of pollutant emissions from specific sources can be better understood. The EPA plans to acquire plume tracking ability

through this cooperation with the German research team, to give it another tool to diagnose air pollution sources and evaluate air quality.

Environmental Monitoring

IoT Smart Enforcement Application Wins 2018 Smart City Innovative Application Award

The 2018 Smart City Summit & Expo began on 27 March. The EPA received the Innovative Application Award presented by President Tsai Ing-Wen for its “Smart Environmental Management: Environmental Internet of Things Smart Enforcement Application.” The EPA presented the environmental IoT’s deployment and applications at the Nangang Exhibition Center.

With the development of information and communication networks and microsensor technology over recent years, the EPA is now able to use the newest IoT technology for its plan to connect Taiwan’s air quality

sensors and microsensor systems. This project answers President Tsai Ing-Wen’s call to create an Asian Silicon Valley, allowing Taiwan to become an IoT research and development center and test area. As such, the EPA created an

environmental quality sensing IoT.

The EPA received the award for its integrated technology, “Smart Environmental Management: Environmental IoT Smart Enforcement Application.” There were



President Tsai Ing-Wen (left) presents the Innovative Application Award to the EPA for its "Smart Environmental Management: Environmental Internet of Things Smart Enforcement Application" program.

several factors that contributed to this project's success. The EPA integrated air quality sensing equipment at industrial developments, overcame energy issues for field deployment and set up a system for screening and reviewing aggregated data. The environmental IoT features innovative analysis and visualization applications. Kwanyin Industrial Park in Taoyuan, Yingge and Dalinpu served as trial areas for the early stages of the project. During the implementation process, each sensor node was closely connected.

For example, sensors in the grid were designed to monitor PM_{2.5} in addition to volatile organic compounds (VOCs), temperature and humidity in order to improve big data analysis. The monitoring of the sensor network is done on a minute-by-minute basis and at the street level, allowing the system to create a visualization of changes in pollutant density over time. Monitoring sensors for wind speed, wind direction, pollution hotspots and potential emission areas are included for analyzing spatial and time characteristics. The conclusions can be used

for inspection and dispatch operations.

The EPA's display at the Nangang Exhibition Center included a demonstration of air quality microsensors and the environmental IoT digital data platform with its capabilities. There was also a display for AI learning and smart inspection applications. The EPA also used augmented reality (AR) to allow visitors to learn more about the distribution of potential air pollution hotspots.

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