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Perspectives on resource recycling from municipal solid waste in Taiwan

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Abstract

Taiwan, a nation with a high population density and a lack of natural resources, depends on imports for almost 100% of its energy and metal needs. Municipal solid waste (MSW) management has become a vital environmental issue in the country. In this regard, resource recycling is thus becoming attractive and part of environmental and economic policies for promoting sustainable development and for attaining the goal of "zero waste" in recent years. The objective of this paper is to present an integrated evaluation of MSW in light of Taiwan's government laws and regulations. The description first focuses on the current status of MSW generation and clearance and its recycling. It also centers on new, revised legislation and regulations (especially policies concerning environmental protection and financial incentives for MSW recycling), which have become effective since 1997. The regulatory system (i.e., Waste Disposal Act, Environmental Basis Law, and Statute for Upgrading Industries) is not only to give financial incentives, but also to provide technical assistances and transfer of information for promoting resource recycling. As a newly developed country, Taiwan's recycling system—the "4-in-1 Recycling System", which includes the Resource Recycling Management Fund—has successfully proceeded and will provide a cost-effective demonstration for those countries that are developing their resource recycling from MSW.

Keywords: Resource recycling; Environmental policy; Legislative system; Financial incentive

Introduction

Taiwan, located in the southeastern rim of Asia, is a small island country with a total of ca. 36,000 km^2 (Hsiao et al., 2001). By the end of 2005, Taiwan with a population of approximately 23 million ranked second in population density in the world. Furthermore, this nation only possesses limited natural resources with over 98% energy and ca. 100% metal minerals from imports (BOE, 2005). With the rapid industrialization, economic development and welfare during the past decades, heavy environmental loadings in Taiwan caused some serious environmental pollution such as illegal dumping of municipal solid waste (MSW). Consequently, the Environmental Protection Administration (EPA), the central competent authority responsible for environmental issues, began to promulgate stringent regulation and invest in the build-up of the publicly owned incinerators and sanitary landfills to treat and dispose of MSW started in the early 1990s (Tsai and Chou, 2006). However, this approach evidently lacks in creating environmental benefits because of concerned about issues such as polychlorinated dibenzodioxin/polychlorinated dibenzofuran (PCDDs/PCDFs) emissions from incinerator and groundwater contamination from landfill, even if the approach is successful in achieving a desired level of MSW treatment/disposal. As compared to command-and-control policies, policies based on economic incentives are more cost-effective and are better able to promote technological innovation—in other words, the residential, commercial and industrial sectors favored the adoption of incentive-based instruments such as violation

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punishment, public reward, tax deduction, R&D subsidies and investment subsidies, and they also objected to the stringency of the regulations (Kemp, 1997).

In the late 1970s, it was accepted that the overuse of natural resources in manufacturing/processing and marketing/consuming of commodities, and subsequent storage, treatment and disposal of resulting wastes would not achieve the goal of environmentally sound management and environmental quality demanded by the public and government. For example, the US Congress passed the Resource Conservation and Recovery Act (RCRA) in 1976. In contrast, Taiwan's resource recycling from MSW was first promulgated on the basis of the revision of Waste Disposal Act (abbreviated as WDA) in 1988, and was formally established with the mandatory recycling of polyethylene terephthalate (PET) bottles in 1989 (Yang, 1995; Lee et al., 1998). Thereafter, in order to fulfill the obligation to protect the environment and incorporating sustainable development concepts into governmental regulations, the Executive Yuan of Taiwan established the National Council for Sustainable Development (NCSD) in August 1997. Under the organization structure of the NCSD, the Premier acts as Chairman of the Council in order to provide concrete policies and measures in promoting sustainable development. Meanwhile, the WDA was significantly revised to promote the implementation of the "4-in-1 Recycling System" in March 1997; this four parts of the system focus on MSW generation, collection, recycling, and the innovative Resource Recycling Management Fund that provides incentives for recycling. The system is a polluter-pays model of sharing the recycling duty among the responsible enterprises because they shall pay the recycling fee for the recycling subsidies under the Resource Recycling Management Fund (Fan et al., 2005). Manufacturers or importers of goods and containers (thereafter called responsible recyclable resources) pay fees set by the Recycling Fee Review Committee to financial institutions for the replenishment of the Recycling Fund. The Fund is used to subsidize back-end collection and treatment, which gives the private firms (thereafter called certified collection/treatment enterprises) more incentive to engage in recycling. To establish national sustainable development policy in combination with environmental, economic, technological and social development, the legislation of the Environmental Basis Law (EBL) was passed and promulgated in November 2002. With regard to economic and financial incentives pertaining to waste recycling, the law (Statute for Upgrading Industries, SUI) has been amended since 1999 and related regulations have thereafter been issued for further promoting green industries or recycling industries.

Previous studies (Lee et al, 1998; Fan et al, 2005; Hsu and Kuo, 2005) focused on the management and performance of the "4-in-1 Recycling System" and the Resource Recycling Management Fund, and also showed a lack of regulatory systems and environmental and financial policies for promoting MSW recycling. Most of the data in the previous papers were furnished only up to 2002. Therefore, the objectives of this paper are to present an updated review and innovative information on resource recycling of MSW in Taiwan. These approaches will play a relevant role in integrated waste management policies that will be expected to offer cost-effective strategies and to provide a successful case for other "developing" countries. The main subjects covered in this paper are listed in the following key elements:

- Current status of MSW generation and clearance.
- Current status of resource recycling from MSW.
- Regulatory framework of resource recycling from MSW.
- Environmental policy on upgrading resource recycling from MSW.
- Economic and financial encouragement for resource recycling from MSW.

Current status of MSW generation and clearance

According to the definition in Taiwan's solid waste legislation (i.e., WDA) described later, wastes are classified into two categories: general wastes and industrial wastes. "General wastes" are defined as follows: these wastes include garbage, excrement and urine, animal corpses in solid or liquid form generated by households or other non-industries, which will pollute the environment. Obviously, the general waste is almost identical to MSW, which is normally assumed to include all non-industrial community wastes such as residential wastes, commercial wastes, institutional wastes (excluding laboratories and wards) and municipal service wastes (excluding treatment facilities) (Tchobanoglous et al., 1993). Furthermore, MSW are currently classified into three major categories: recyclable MSW, non-recyclable/non-hazardous MSW, and hazardous MSW (Fig. 1). The recyclable MSW have been basically divided into regulated recyclable resources and non-regulated recyclable resources. The former includes specified recyclable resources (including kitchen waste) and responsible recyclable resources, which are officially determined and announced under the authorization of WDA. The responsible recyclable resources, however, imply that their original manufacturers or importers shall bear responsibility for paying recycling fees for the purpose of establishing Resource Recycling Management Fund, which will be introduced later. The specified recyclable resources mean that those are designated as mandatory recyclables by the central competent authority (i.e., EPA) and are subsequently collected by the local competent authorities (called enforcement authorities); namely, they must be forcibly sorted by their generation sources (people) and then carried to local recyclable resources vehicles at the specified time. The latter (e.g., used clothing, used bicycles) belong to recyclable resources from the viewpoint of property or material, but it has not been specifically