

出國報告（出國類別：考察）

赴韓國勘查廢乾電池輸出境外處理
情形與廢照明光源回收體系及技術
出國報告

服務機關：行政院環境保護署

姓名職稱：葉明昇 環境技術師

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摘要

本次考察係以韓國再生處理業者為主要對象，目的在勘察我國廢乾電池輸出至韓國 Kobar 公司處理情形，及瞭解韓國廢乾電池及廢照明光源回收再生體系現況，並藉由韓國環境部與廢乾電池及廢照明光源回收組織考察，得知其體系實際運作情形，且進行經驗交流。

韓國自 2003 年起開始實行延長生產者責任（EPR）計畫，主要是由「資源減用及回收再生推動法」授權執行，目的在減少從生產到銷售、使用、廢棄各階段之資源使用後所產生廢棄物，及清楚定義政府與責任業者之責任與應遵守規範以改善資源循環再生。韓國環境部就各材質訂定有長期目標回收率，目標回收率每 5 年更新 1 次，2010 年整體回收量達 145 萬公噸，不但減少掩埋焚化支出，增加再生產品衍生之經濟價值，同時創造許多就業機會。其部分作法可供我國推動資源回收相關工作參考。

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壹、前言

「垃圾是放錯位置的資源」，檢視國內所產生一般廢棄物中，仍有許多可資源回收再利用物質，因此藉由廢棄物回收清除處理與資源再生管道的推動，可有效促使廢棄物減量並達到資源回收實質目的，而先進國家之廢棄物清理政策已由單純之廢棄物清理調整兼顧分類回收、減量及資源再利用之綜合性廢棄物管理。因此，如何運用有限資源進行再利用應是每個國家基本環境政策。

廢乾電池部分，本署自 87 年 7 月公告應回收之廢乾電池項目包括水銀電池及鎳鎘電池，自 88 年 11 月起修正廢乾電池項目，全面回收各項廢乾電池，其中包括錳鋅電池、鹼錳電池、鈕釦型及一次鋰電池、氧化銀電池、氧化汞電池及鋅空氣電池及可重複使用之二次電池，包括鎳鎘電池、鎳氫電池及二次鋰電池。由於廢乾電池內含有害之微量重金屬及可再利用物質，於廢棄後實有必要回收其有害成分，且大部分材質亦可回收作為原料再利用，有助資源循環再利用。國內廢乾電池處理成效於近 3 年來已有顯著提昇，99 年至 101 年廢乾電池平均回收率達 41% 以上，已接近歐盟要求其會員國於 2016 年達到之目標 45%。

而在廢照明光源部分，因部分產品內含有害物質之汞、螢光粉及重金屬，若未妥善回收處理亦將對人體與環境產生危害。本署自民國 91 年 1 月 1 日起，依據『廢棄物清理法』之規定，公告照明光源為應回收廢棄物項目，目前公告之應回收照明光源種類包含日光燈管之直管部分及環管日光燈、安定器內藏式螢光燈泡（即俗稱省電燈泡）、緊密型螢光燈管、白熾燈泡（燈帽直徑為 2.6 公分以上）、高強度照明燈管（HID）之非直管廢照明光源，並將於 103 年 3 月新增公告回收冷陰極燈、感應式螢光燈及其他汞燈。國內廢照明光源自 91 年公告回收以來其回收率即呈穩定成長，99 年至 101 年平均回收率已達 81% 以上。

我國廢乾電池處理方式採國內處理及輸出境外處理 2 種方式，為瞭解輸出之廢乾電池處理情形，故本次前往韓國勘察我國廢乾電池輸出至韓國 Kobar 公司處理情形，及瞭解韓國廢乾電池及廢照明光源回收再生體系現況，汲取其優點及可參考處，以作為我國未來資源回收再生相關政策研擬之參考。

貳、考察目的

近年來國際間對於含汞一般廢棄物之處理，均依循「逐年限汞、最終禁汞」之原則，各國無不全力以赴針對廢乾電池及廢照明光源等含汞物質進行回收宣導及技術研發，歐盟已要求各會員國針對廢乾電池回收，於 2012 年需達成 25%，2016 年需達成 45% 之回收率；而廢照明光源則因近年節能減碳及省電燈具盛行，亦成為另一項重要的回收課題。本次考察韓國再生處理業者，勘察我國廢乾電池輸出至韓國 Kobar 公司處理情形，以及參訪韓國環境部與廢乾電池及廢照明光源回收組織，其目的說明如下：

- 一、藉由參訪韓國環境部資源循環再生政策部門，針對目前韓國廢棄物回收再生管理、廢棄物立法、回收再生規範及其執行架構，以及廢乾電池與廢照明光源之回收再生現況進行意見交流，以拓展台灣環保之國際視野並瞭解韓國廢棄物資源回收處理之趨勢。
- 二、參訪韓國廢乾電池回收組織 KBRA，瞭解該組織運作與環境部、電池責任業者及後端回收處理業之責任義務關係，並就其組織回收執行方式、境內回收管道來源、回收點設置、回收成果、政府規範之回收率及回收宣導方式與我國現況進行經驗交流。
- 三、參訪韓國廢照明光源回收組織 KLRA，瞭解其組織運作情形、廢照明光源回收種類、回收體系架構、分類方式、回收管道設施、回收成果及其再生處理技術，並就我國廢照明光源回收體系架構及相異處進行經驗交流。
- 四、考察韓國廢乾電池再生處理業者 Kobar Limited，針對該公司之投資成本、設置規範、處理種類、處理技術及量能、於國內回收與接收國外廢乾電池處理情形及其後端再生料運用進行瞭解，作為未來國內設置二次電池處理廠之參考，並可建立資訊交流管道。

參、考察參訪行程表

日期	行程	考察重點摘要
102.08.26 (一)	台北→韓國仁川 →京畿道	啟程，搭機出發至韓國仁川。
102.08.27 (二) 上午	京畿道→首爾	參訪韓國環境部資源循環再生政策部門，拜會資源循環再生處副處長鄭文熙 (Jung, Mun-Hee)，針對目前韓國廢棄物回收再生管理、廢棄物立法、回收再生規範及其執行架構，以及電池與廢照明光源之回收再生現況進行意見交流，會晤期間副處長與業務相關承辦人員列席參與，並以簡報及問答方式相互討論。
102.08.27 (二) 下午	首爾→KBRA	考察韓國廢乾電池回收組織 Korea Battery Recycling Association，拜會會長金聖贊、課員李時晶 (Lee, Si Jung) 等人，針對該組織運作情形、與環境部、電池責任業者及後端回收處理業之責任義務關係進行瞭解，並就其組織回收執行方式、境內回收管道來源、回收點設置與我國現況進行經驗交流，另就其廢乾電池回收成果、政府規範之回收率及回收宣導方式進行瞭解。
102.08.28 (三)	首爾→KLRA	考察韓國廢照明光源回收組織 Korea Lighting Recycling Association，拜會會長 Kim Chang Kweon、執行長鄭樂訓 (Chung, Nack Hoon) 及技術顧問 Michael A Lee，瞭解其組織運作情形、廢照明光源回收種類、回收體系架構、分類方式、回收管道設施、回收成果及其再生處理技術，並就我國廢照明光源回收體系架構及相異處進行經驗交流。
102.08.29 (四)	京畿道→釜山	考察廢乾電池再生處理業者 Kobar Limited，拜會總裁朴琮熙 (J. H. Park)，針對該公司之投資成本、設置規範、處理種類、處理技術及量能、於國內回收與接收國外廢乾電池處理情形及其後端再生料運用進行瞭解，並由總裁親自帶領參觀其廠區廢乾電池處理設備及運作情形。
102.08.30 (五)	韓國仁川→台北	返程，於韓國仁川國際機場搭機返回台灣。

肆、考察過程

一、韓國環境部參訪及交流

本次參訪係以韓國再生處理業者為主要對象，目的在勘察我國廢乾電池輸出至韓國 Kobar 公司處理情形，及瞭解韓國廢乾電池及廢照明光源回收再生體系現況，並藉由韓國環境部與廢乾電池及廢照明光源回收組織考察，得知其體系實際運作情形，汲取其優點及可參考處，以作為我國未來資源回收再生相關政策研擬之參酌。以下就韓國環境部參訪及交流內容進行說明。

(一)韓國延長生產者責任系統

韓國自 2003 年起開始實行延長生產者責任 (EPR) 計畫，主要是由「資源減用及回收再生推動法」授權執行，目的在減少從生產到銷售、使用、廢棄各階段之資源使用後所產生廢棄物，及清楚定義政府與責任業者之責任與應遵守規範，以改善資源循環再生。目前韓國回收體系架構包含有消費者、責任業者 (生產者責任組織 PRO，即回收組織)、地方政府、KECO (法律授權監督回收處理執行之組織，屬非政府及非營利組織) 及環境部 (負責整體 EPR 計畫、法規修正、許可回收組織成立、支持及管理地方政府與 KECO 及制訂目標回收率)，其回收體系角色與功能詳圖 1 所示。

(二)責任業者範圍

責任業者定義為涵蓋在延長生產者責任 (EPR) 計畫內物品及包裝材料之製造商及進口商，製造商包含使用列管包裝材料之產品製造商 (國內製造商依據品牌擁有權來界定，負擔商品或包裝之責任)，進口商則不論品牌均屬於責任業者。企業製造使用包裝材料之產品界定為責任業者，若屬代工情形 (OEM)，要求代工之品牌擁有者則為責任業者而非實際製造者。為保護小規模業者，須視業者之銷售量或進口量決定是否納入責任業者範圍，業者規模條件乃由「資源減用及回收再生推動法」實施細則第 4 條內容規範，業者必須符合相關條件始得界定為責任業者，包裝材質製造業者前 1 年營收須達 10 億韓幣或更高，銷售量須達 4 公噸以上或更高，而進口者前 1 年營收須達 3 億韓幣或更高，銷售量須達 1 公噸以上或更高，始得界定為責任業者並負責履行 EPR 相關責任。

角色	功能
消費者	<ul style="list-style-type: none"> 分類及排出可回收物 遵守地方政府規範 分類各類包裝材質及紙類產品、橡膠手套、塑膠袋等
生產者（生產者責任組織PRO）	<ul style="list-style-type: none"> 完成回收再生責任（可透過合約轉嫁） 監督回收再生執行（PRO） 完成包裝材質需回收標誌標示之責任
地方政府	<ul style="list-style-type: none"> 回收分類EPR規範之項目 依據分類回收系統準則建立回收再生系統
KECO	<ul style="list-style-type: none"> 接受及批准生產者提報之銷售進口紀錄 接受及驗證回收再生成果 管理環境部執行計畫，監督再生處理作業執行
環境部	<ul style="list-style-type: none"> 負責整體EPR計畫、法規修正 許可回收組織成立 支持及管理地方政府與KECO及制訂目標回收率

圖 1 韓國回收體系角色與功能

(三)回收項目及目標回收率

韓國目前回收項目包括包裝材質(含容器)、電子電器包裝材質、塑膠袋、電池、輪胎、潤滑油、螢光燈、聚苯乙烯泡沫塑料(保麗龍)、電器產品等 9 大類，回收細項詳表 1 所示。

表 1 韓國回收項目材質

項目	EPR 列管物品及包裝材質	
包裝材質(含各類容器)	紙包裝、玻璃瓶、金屬罐、塑膠包裝等	
電子電器包裝材質	紙狀或片狀之包裝吸震材質如發泡塑膠	
塑膠袋	體積計量收費之塑膠袋除外	
物品	電池	汞電池、氧化銀、鎳鎘、一次鋰、錳鋅/鹼錳、鎳氫電池
	輪胎	依據車輛管理法界定範圍
	潤滑油	不包含出港及遠洋漁船使用
	螢光燈	含汞螢光燈
	保利龍	水域作為漂浮使用
	電器產品	2008 年轉由環境友善確認系統進行管理

韓國環境部就各材質訂定有長期目標回收率，長期目標回收率每 5 年更新 1 次，並作為目標回收率之計算基礎，有其特定計算方式如下。

$$\text{目標回收率} = \text{去年目標回收率} + (\text{長期目標回收率} - \text{前年回收率}) \times \text{目標回收率反映係數} + \text{調整係數} (-0.05 \sim 0.05)$$

- 長期目標回收率由環境部每 5 年公告 1 次
- 回收率 = 總回收量 / 總營業量
- 目標回收率反映係數：第 1 年 1/5、第 2 年 1/4、第 3 年 1/3、第 4 年 1/2、第 5 年 1
- 調整係數為考量回收因子而定

韓國 2013 年目標回收率詳表 2 所示，目標回收率可視作實際回收率，因當年度若未達到目標回收率仍須針對不足比率部分繳交 130 % 之回收處理費，而 2011~2015 年之長期目標回收率詳表 3 所示，至於回收率計算方式則為當年度回收量除以營業量。

表 2 2013 年目標回收率

項目	2013 目標回收率	項目	2013 目標回收率
紙包裝	0.341	汞電池	0.600
玻璃瓶	0.760	氧化銀電池	0.560
鐵罐	0.786	鋰電池	0.650
鋁罐	0.786	鎳鎘電池	0.400
PET 瓶	0.806	錳電池	0.216
彩色 PET 瓶	0.806	鎳氫電池	0.203
複合材質 PET 瓶	0.806	電視	0.362
EPS	0.781	冰箱	0.343
PSP	0.423	洗衣機	0.388
PVC	0.664	冷氣機	0.088
塑膠容器盤	0.800	電腦	0.229
薄或紙狀塑膠材質	0.600	收音機/音響	0.268
潤滑油罐	0.795	手機	0.399
潤滑油	0.725	影印機	0.234
輪胎	0.762	傳真機	0.223
螢光燈	0.328	印表機	0.218
發泡塑料	0.285		

表 3 2011~2015 各材質長期目標回收率(每 5 年公告 1 次)

項目	長期目標回收率	項目	長期目標回收率
紙包裝	0.360	汞電池	0.600
玻璃瓶	0.793	氧化銀電池	0.560
鐵罐	0.831	鋰電池	0.650
鋁罐	0.816	鎳鎘電池	0.400
PET 瓶	0.830	錳電池	0.213
EPS	0.805	鎳氫電池	0.153
PSP	0.423	電視	0.431
PVC	0.733	冰箱	0.389
塑膠容器盤	0.845	洗衣機	0.392
薄或紙狀塑膠材質	0.675	冷氣機	0.080
潤滑油罐	0.790	電腦	0.260
潤滑油	0.730	收音機/音響	0.278
輪胎	0.770	手機	0.400
螢光燈	0.394	影印機	0.280
發泡塑料	0.277	傳真機	0.250
		印表機	0.243

(四)履行回收再生義務

為符合回收再生規範，責任業者可選擇 3 種不同方式履行回收再生義務，首先為自行回收處理並遞交執行計畫與成果予 KECO 組織，其次可採再生處理業合作方式以完成回收再生作業，同時遞交執行計畫與成果予 KECO 組織，最後可藉由回收組織（PRO）協助完成廢棄產品之回收再生並由回收組織遞交執行計畫與成果予 KECO 組織，此 3 類方式之流程關係詳圖 2 所示。目前韓國境內大部分責任業者均採透過回收組織方式進行回收處理。

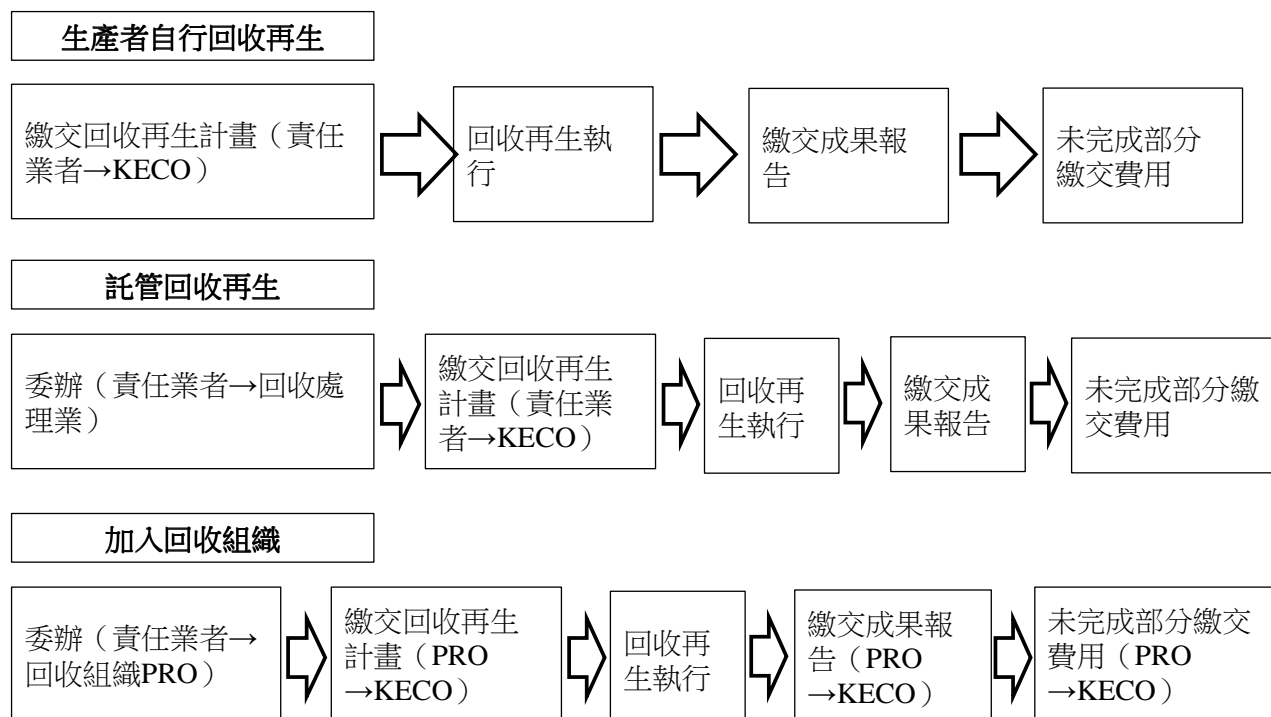


圖 2 履行回收再生義務流程

(五)KECO 組織概況

KECO 組織宗旨在透過有效執行溫室氣體減量計畫防止環境污染、改善環境、促進資源回收再生及因應氣候變遷等工作，達到韓國環境友善發展之目的 (KECO Act, 法規編號 11446)，該組織建置乃基於「韓國環境合作法 (Korea Environment Cooperation Act)」第 1 條：本法目的在建立韓國環境合作社，致力於處理環境相關計畫，如污染防制、環境改善及資源循環，並以最大效率建立資源循環管理系統，同時展現國家發展之環境友善藍圖。KECO 組織之策略目標包括創造 6,000 億韓幣之商業收入、完成顧客滿意度之最高標準及培養 800 人以上博士專家，其 4 大策略涵蓋環境機構發展 (改善環境監測品質、建置及操作環境機構之最佳化、擴展能源保育基礎)、環境服務品質改善 (發展資源回收再生管理系統、改善生活環境、發展環境污染分析能力)、強化永續發展基礎 (強化對環境變遷之反應基礎、改善海外市場環境發展、改善環境顧問)、組織最大化 (執行管理之發展、培養不同領域才能、強化公司核心) 等面向。

KECO 組織總裁下設有公共關係辦公室、環境安全中心、溫室氣體認證中心，平行於總裁職位另設有審查長及其直屬審查辦公室。組織主要由 5 大

部門組成，即管理支援總部、氣候及空氣品質管理總部、水環境管理總部、資源循環管理總部、環境機構支援總部等，目前員工有 1,957 人，高階主管 7 位，一般員工 1,543 人，技術員工 401 人，特定政府職位員工 6 位。其組織架構詳圖 3 所示。

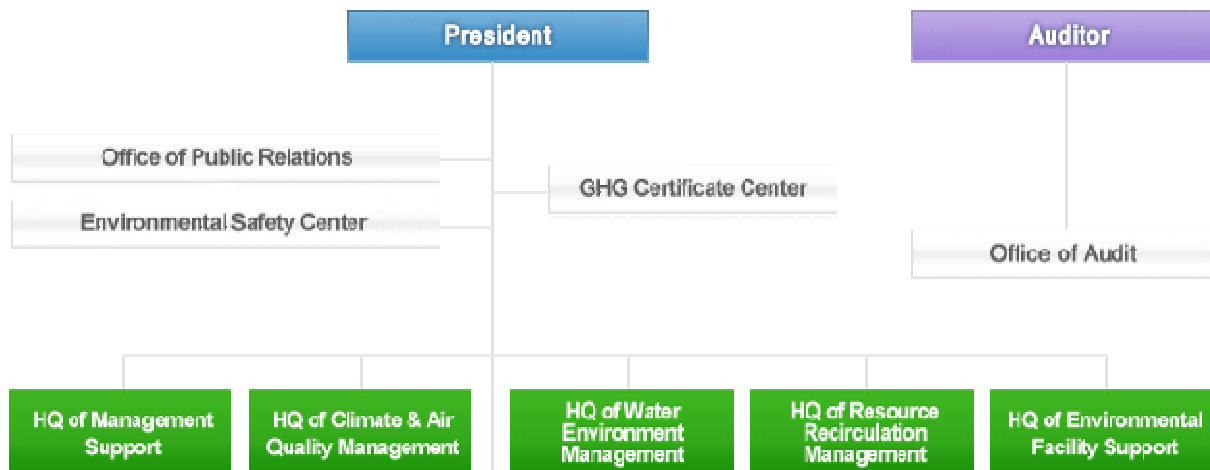


圖 3 KECO 組織架構

KECO 組織主要核心工作分為 5 項，對應其 5 大部門，各部門主體工作重點為：回應氣候變遷及溫室氣體減量、水環境之改善、建立資源循環管理系統、環境公共衛生服務、政策支援及環境工業支援。

(六)回收成果及現況

根據韓國環境部統計，2010 年責任業者家數達 4,386 家，回收處理業數量也增加到 590 家，整體回收量達 145 萬公噸，有關 2002~2010 逐年回收成果詳圖 4 所示。

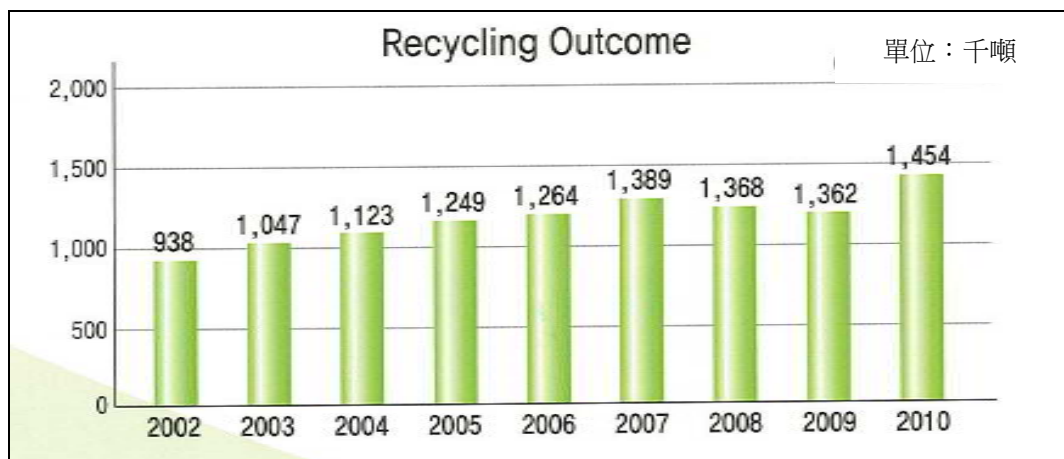


圖 4 2002~2010 逐年回收量

資源回收所促成之經濟效益方面，在過去 8 年 EPR 系統執行下，估計掩埋（焚化）支出節省約 43,470 億韓幣，約 1,025,100 萬公噸包裝材料及產品經回收處理後製造成再生產品，創造約 2,169 億韓幣經濟價值，同時在過去 8 年創造了約 7,000 人就業機會。

2011 年韓國責任業者總數已增加到 5,610 家，其中 55%（3,070 家）加入回收組織，45%（2,533 家）直接與回收處理業合作，0.1%（7 家）則自行回收處理。韓國環境部主要針對加入回收組織（PRO）之不同業者類別進行統計，並無另行統計業者直接與回收處理業合作及自行回收處理之類別，有關各類別回收項目之責任業者（加入回收組織之 3,070 家）統計如表 4 所示。

表 4 2011 年各類回收項目之責任業者家數

項目	責任業者家數
罐	266
玻璃瓶	418
紙包裝	51
PET 瓶	376
EPS	276
塑膠	1,446
潤滑油	30
輪胎	15
螢光燈	38
電池	38
電子電器設備	116
TOTAL	3,070

在韓國除了政府所規定之資源物可免費回收外，一般廢棄物均以付費塑膠袋盛裝後回收掩埋或焚化，此方面與我國政策類似；廚餘方面同樣需以付費塑膠袋盛裝，大部分作為飼料或沼氣生產使用。資源物由地方政府或其委辦公司進行分類，並以銷售或無償方式繳交予私人再生處理業，韓國境內廢乾電池回收由 KBRA 回收組織負責，主要會員為 41 家電池製造輸入商及回收處理業，其 2011 年回收量達 2,068 公噸；廢照明光源回收則由 KLRA 回收組織負責，主要會員為 32 家照明光源製造輸入商及回收處理業，其 2011 年回收量達 4,969 公噸。

有關韓國環境部參訪交流情形如圖 5 所示。



圖 5 韓國環境部參訪交流情形

二、廢乾電池回收組織（KBRA）參訪

（一）組織簡介

廢乾電池回收組織 KBRA 於 2003 年創立後開始執行回收作業，目前員工含現場工作人員僅 6 人，其組織經費來源為責任業者依據目標回收率所需回收處理成本支付，送至 KBRA 組織之廢乾電池多為免費，來源 80% 為政府清潔隊，20% 為部隊、私人公司，之後再付費交由後端 5 家廢乾電池處理業進行再生處理。

（二）回收現況

韓國境內回收點設置多為學校、公務機關、社區、便利商店等，但並無規範強制設置，由各單位決定是否放置回收設施。回收宣傳方面則多由海報、報紙、交通場站張貼方式進行宣傳，主要由地方政府規劃執行，至於中央補助地方清潔隊經費則視地方回收率高低而定，且清潔隊屬地方政府管轄而非環境部。

（三）回收成效

根據 KBRA 回收組織統計資料顯示，2012 年氧化銀、鋰一次及鎳鎘電池回收率已達 40% 以上，僅錳鋅/鹼錳電池與鎳氫電池回收率約在 20% 左右，由於此 2 類電池於 2008 年始開始回收，推論回收率偏低與民眾回收觀念尚未落實有關。韓國 2003~2012 年各類電池回收率詳表 5 所示，錳/鹼性電池 2008~2013 年回收量變化如圖 6 所示

表 5 2003~2012 年各類電池回收率

項目	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
氧化銀	90.0%	90.0%	25.0%	25.0%	30.9%	37.0%	39.0%	42.4%	49.9%	56.0%
鋰一次	20.0%	29.0%	24.9%	29.3%	38.0%	49.0%	52.0%	57.7%	58.2%	65.0%
鎳鎘	20.0%	23.0%	24.6%	24.6%	25.7%	29.1%	31.0%	33.3%	38.3%	40.0%
錳/鹼性						20.0%	20.5%	23.6%	19.2%	21.6%
鎳氫						25.0%	25.0%	28.9%	13.6%	20.3%

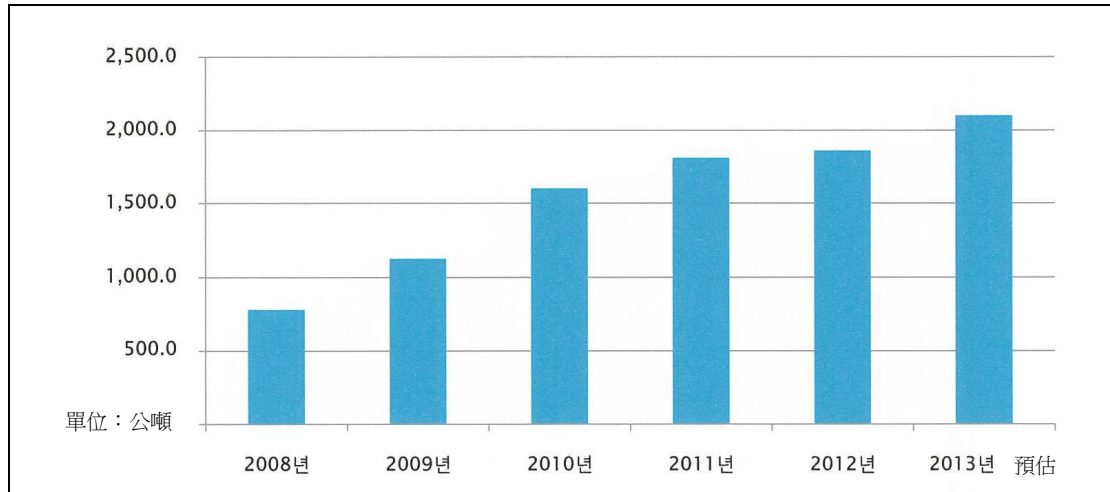


圖 6 2008~2013 年錳/鹼性電池回收量

有關廢乾電池回收組織 KBRA 參訪情形如圖 7 所示。



KBRA 辦公室（廠房在後方）

與 KBRA 組織接待人員（圖左）合影

圖 7 廢乾電池回收組織 KBRA 參訪情形

三、廢照明光源回收組織（KLRA）參訪

（一）組織簡介

廢照明光源回收組織 KLRA 於 2000 年 12 月與環境部簽署協議，經過示範工作期間，於 2004 年投入生產者回收責任制度並開始執行回收作業，其組織經費來源為責任業者依據目標回收率所需回收處理成本支付，回收後之廢照明光源再付費交由後端 3 家廢照明光源處理業進行再生處理。

（二）回收現況

回收點設置多為學校、社區、公務機關，回收清運工作為地方政府清潔隊負責，部分回收點有電池與照明共用之回收桶設置，回收貯存設施多採紙箱或塑膠箱以減少破損機率，多由地方政府提供。照明光源回收與其他資源物不同點在於其含有害物質汞，回收目的主要為安全處理而非經濟上之資源再利用。

（三）回收成效

根據 KLRA 統計數據，目前直管回收率約 65%、環管 5%、安定器內藏型 15%、緊密型 10%，整體回收率上不足 30%，與我國回收率 80% 以上相去甚遠，且目前針對 CCFL 及 LED 燈並無相關策略及回收規劃，有關各地區廢照明光源逐年回收量詳表 6 所示。惟其針對市售照明光源訂有汞含量限值，直管、環管及緊密型為 8~10mg/支，安定器內藏型則為 4~5mg/支，與歐盟 RoHS 規範（直管 3~4 mg/支、緊密型及安定器內藏型 2.5~3.5 mg/支）相比較仍較為寬鬆。

表 6 2004~2011 年各地區廢照明光源回收量

單位：千支

Year	2004	2005	2006	2007	2008	2009	2010	2011
Seoul	8,666	10,171	11,119	8,809	10,231	10,894	11,303	12,080
Gyeonggi	4,612	6,931	6,904	6,062	6,436	6,627	7,458	7,766
Incheon	1,485	1,665	2,006	1,807	1,907	2,026	2,032	2,454
Daejeon	463	1,010	1,370	1,174	1,631	1,649	1,817	2,082
Daegu	108	478	355	538	415	634	680	677
Ulsan	124	288	510	598	737	939	866	740
Busan	755	1,855	1,677	1,826	2,169	2,234	2,425	2,514
Chungcheongbuk	149	556	741	757	703	909	888	1,019
Chungcheongnam	134	495	740	756	833	883	1,167	1,173
Jeollabuk	28	356	1,020	1,352	1,238	1,251	1,259	1,460
Jeollanam	162	460	686	664	760	613	759	804
Gyeongsangbuk	45	238	535	675	899	945	980	1,149
Gyeongsangnam	411	1,305	1,140	1,288	1,456	1,486	1,639	1,625
Gwangju	103	206	215	253	389	530	933	1,176
Jeju	31	117	184	252	271	286	279	399
Gangwon	84	258	337	465	627	741	778	826
Total	17,369	26,398	29,546	27,282	30,711	32,654	35,269	37,951

(四)再生處理技術

螢光燈管組成（玻璃、螢光粉、管端）分別經過汞處理裝置處理及收集，處理設備內的汞蒸氣透過活性碳吸附之完善安全處理程序。再生汞會送到照明光源製造工廠作為原料使用，一部分再生玻璃製成玻璃纖維，但大部分沒有經濟上的價值，重點在安全處理。有關韓國廢照明光源處理流程詳圖 8 所示。

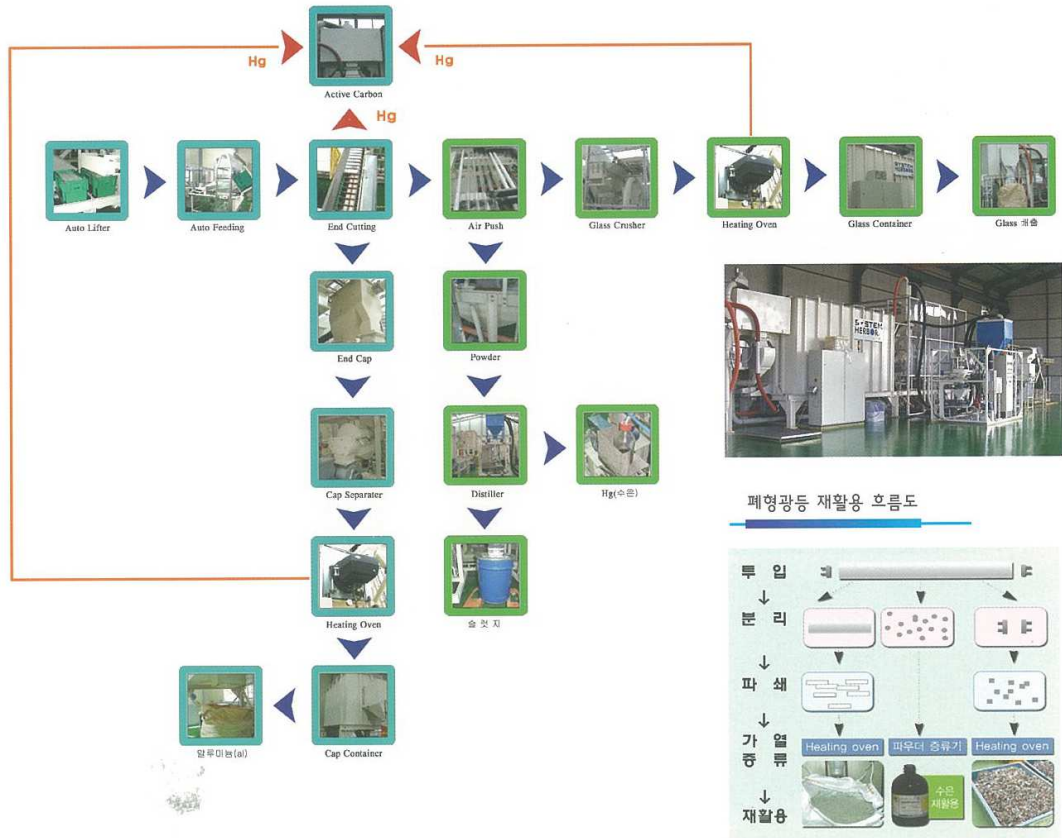


圖 8 韓國廢照明光源處理流程

有關廢照明光源回收組織 KLRA 參訪情形如圖 9 所示。



KLRA 辦公室外舊衣回收袋 (箱)

與 KLRA 組織執行長 (圖左) 合影

圖 9 廢照明光源回收組織 KLRA 參訪情形

四、廢乾電池處理業者（Kobar Limited）再生處理技術及運作

（一）工廠簡介

韓國廢乾電池處理業者 Kobar Limited 係以高溫熔爐方式進行處理，主要處理項目包含鎳氫、鎳鎘、鋰電池及其他一次電池，其投資設置成本約為 10 億韓幣，同時須申請並獲得環境部及地方政府許可後始得營運，該廠最大處理量為 1,500 公噸/年，目前年處理量約為 1,200 公噸，其廢電池來源韓國本地約占 33%，67%均來自國外如澳洲、委內瑞拉、印尼、香港及新加坡等亞洲國家，現已開始處理電動車用電池，廠內進貨之廢乾電池均已完成分類及放電工作（二次鋰電池須放電）。

（二）再生處理技術

該廠使用破碎拆解及高溫熔爐處理廢乾電池，操作溫度可達攝氏 850 度，處理設備能源為電能，再生金屬主要利用不同溫度進行分離、收集，處理後之再生利用率接近 100%，種類有鐵鎳合金、鎘錠、鋰鈷及鈷化合物，再交由金屬煉製業精鍊後作為原料使用，至於廢塑膠部分約占 10%，多作為製作 PVC、PE 水管原料摻配使用。有關 Kobar 處理廠之鎳鎘、鎳氫電池及鋰電池處理流程詳圖 10 及 11 所示。

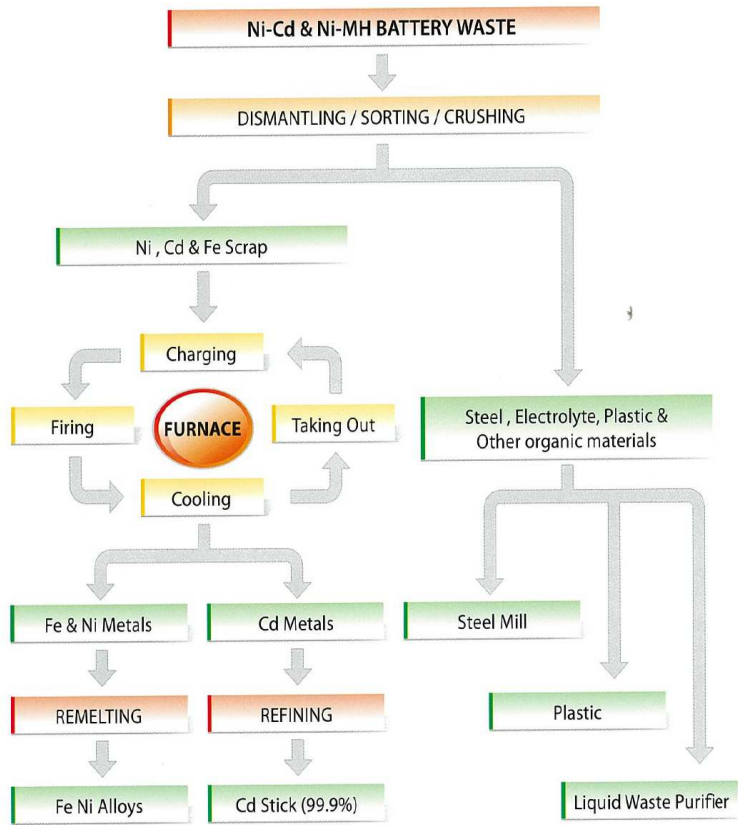


圖 10 鎳鎘及鎳氫電池處理流程

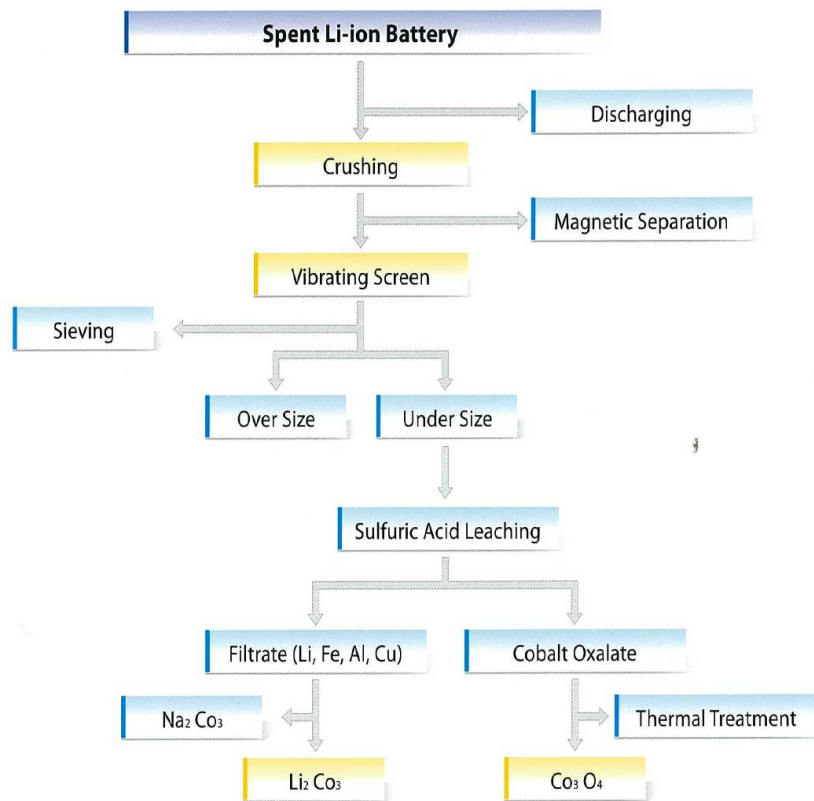


圖 11 鋰電池處理流程

有關廢乾電池處理業 Kobar Limited 處理廠區參觀情形如圖 12 所示。



圖 12 廢乾電池處理業 Kobar Limited 廠區參訪情形

伍、考察心得

本次考察韓國再生處理業者，勘察我國廢乾電池輸出至韓國 Kobar 公司處理情形，以及參訪韓國環境部與廢乾電池及廢照明光源回收組織，得知其體系實際運作情形，汲取其優點及可參考處，以作為我國未來廢乾電池及廢照明光源資源回收再生相關政策研擬之參酌，考察心得如下：

一、韓國延長生產者責任系統

- (一) 韓國自 2003 年起開始實行延長生產者責任 (EPR) 計畫，主要是由「資源減用及回收再生推動法」授權執行，目的在減少從生產到銷售、使用、廢棄各階段之資源使用後所產生廢棄物，及清楚定義政府與責任業者之責任與應遵守規範以改善資源循環再生。目前韓國回收體系架構包含有消費者、生產者 (生產者責任組織 PRO，即回收組織)、地方政府、KECO (法律授權監督回收處理執行之組織，屬非政府及非營利組織) 及環境部 (負責整體 EPR 計畫、法規修正、許可回收組織成立、支持及管理地方政府與 KECO 及制訂目標回收率)。其中責任業者回收組織型態與角色，類似我國 79 至 86 年間之回收共同組織；另 KECO 之角色則類似現在我國之行政院環境保護署資源回收管理基金管理委員會 (以下簡稱回收基管會)，惟韓國 KECO 為非政府非營利組織，而我國回收基管會則屬政府單位。韓國目前回收項目包括包裝材質 (含容器)、電子電器包裝材質、塑膠袋、電池、輪胎、潤滑油、螢光燈、聚苯乙烯泡沫塑料 (保麗龍)、電器產品等 9 大類，韓國環境部就各材質訂定有長期目標回收率，目標回收率每 5 年更新 1 次並有其特定計算方式，而回收率計算方式則為當年度回收量除以營業量。
- (二) 為符合回收再生規範，責任業者可選擇 3 種不同方式，首先為自行回收處理並遞交執行計畫與成果予 KECO 組織，其次可採再生處理業合作方式以完成回收再生作業，同時遞交執行計畫與成果予 KECO 組織，最後可藉由回收組織協助完成廢棄產品之回收再生並由回收組織

遞交執行計畫與成果予 **KECO** 組織。目前大部分責任業者均採透過回收組織方式進行回收處理，其情形亦與我國 79 至 86 年間責任業者大多加入回收共同組織之作法類似。

(三) 根據韓國環境部統計，2010 年責任業者家數已達 4,386 家，回收處理業數量也增加到 590 家，整體回收率達 145 萬公噸，不但減少掩埋焚化支出，增加再生產品衍生之經濟價值，同時在過去 8 年創造了約 7,000 人就業機會。在韓國除了政府所規定之資源物可免費回收外，一般廢棄物均以付費塑膠袋盛裝後回收掩埋或焚化，此方面與我國政策類似；廚餘方面同樣需以付費塑膠袋盛裝，大部分作為飼料或沼氣生產使用。其中資源物免費回收與我國相同，另一般廢棄物付費處理，亦與我國部分縣市相同，而其廚餘需付費處理部分，則與我國免費回收大不相同。韓國資源物由地方政府或其委辦公司進行分類，並以銷售或無償方式繳交予私人再生處理業，韓國境內廢乾電池回收由 **KBRA** 回收組織負責，主要會員為 41 家電池製造輸入商及回收處理業，其 2011 年回收量達 2,068 公噸；廢照明光源回收則由 **KLRA** 回收組織負責，主要會員為 32 家照明光源製造輸入商及回收處理業，其 2011 年回收量達 4,969 公噸。

二、廢乾電池回收組織（**KBRA**）責任義務與運作

廢乾電池回收組織 **KBRA** 於 2003 年創立後開始執行回收作業，目前員工含現場工作人員僅 6 人，其組織經費來源為責任業者依據目標回收率所需回收處理成本支付，送至 **KBRA** 組織之廢乾電池多為免費，來源 80% 為政府清潔隊，20% 為部隊、私人公司，之後再付費交由後端 5 家廢乾電池處理業進行再生處理。韓國境內回收點設置多為學校、公務機關、社區、便利商店等，但並無規範強制設置，由各單位決定是否放置回收設施。回收宣傳方面則多由海報、報紙、交通場站張貼方式進行宣傳，主要由地方政府規劃執行。至於中央補助地方清潔隊經費則視地方回收率高低而定，可供我國推動相關工作之參考。

三、廢照明光源回收組織（**KLRA**）責任義務與運作

廢照明光源回收組織 KLRA 於 2000 年創立後開始執行回收作業，其組織經費來源與廢乾電池回收組織 KBRA 相似，回收點設置亦多為學校、社區、公務機關，回收清運工作為地方政府清潔隊負責，部分回收點有電池與照明共用之回收桶設置，回收貯存設施多採紙箱或塑膠箱以減少破損機率，多由地方政府提供。照明光源回收與其他資源物不同點在於其含有害物質汞，回收目的主要為安全處理，而非經濟上之資源再利用。根據 KLRA 統計數據，目前直管回收率約 65%、環管 5%、安定器內藏型 15%、緊密型 10%，整體回收率上不足 30%，與我國回收率 80% 以上相去甚遠，且目前針對 CCFL 及 LED 燈並無相關策略及回收規劃，惟其針對市售照明光源訂有汞含量限值，直管、環管及緊密型為 8~10mg/支，安定器內藏型則為 4~5mg/支，與歐盟 RoHS 規範（直管 3~4 mg/支、緊密型及安定器內藏型 2.5~3.5 mg/支）相比較仍較為寬鬆。

四、廢乾電池處理業者（Kobar Limited）再生處理技術及運作

韓國廢乾電池處理業者 Kobar Limited 係以高溫熔爐方式進行處理，主要處理項目包含鎳氫、鎳鎘、鋰電池及其他一次電池，該廠最大處理量為 1,500 公噸/年，目前年處理量約為 1,200 公噸，其廢電池來源韓國本地約占 33%，67% 均來自國外如澳洲、委內瑞拉、印尼、香港及新加坡等亞洲國家，現已開始處理電動車用電池，廠內進貨之廢乾電池均已完成分類及放電工作（二次鋰電池須放電）。該廠使用破碎拆解及高溫熔爐處理廢乾電池，操作溫度可達攝氏 850 度，處理設備能源為電能，再生金屬主要利用不同溫度進行分離、收集，處理後之再生利用率接近 100%，種類有鐵鎳合金、鎘錠、鋰鈷及鈷化合物，再交由金屬煉製業精鍊後作為原料使用，至於廢塑膠部分約占 10%，多作為製作 PVC、PE 水管原料摻配使用。其再利用方式可供我國參考。

陸、建議

一、市售照明光源汞含量規範

根據韓國廢照明光源回收組織表示，境內市售照明光源已訂有汞含量限值，即直管、環管及緊密型為 8~10mg/支，安定器內藏型為 4~5mg/支，照

明光源須符合汞含量規範始得上架販售，與我國一次筒型錳鋅/鹼錳乾電池汞含量須符合 5ppm 之源頭管制措施類似，反觀我國，近年來因應國際限汞趨勢，照明光源汞含量亦呈逐年下降，根據相關計畫檢測市售照明光源結果，約 70% 以上已符合歐盟 RoHS 規範標準，故建議可參考歐盟規範，評估市場現況後進一步訂定照明光源汞含量標準，以達逐步限汞、最終禁汞之目的。

二、目標回收率之訂定

韓國目前就其 9 大類資源回收項目均訂有其目標回收率，並有其計算公式，具督促責任業者、回收組織及回收處理業者逐步提升其回收成效。以其廢乾電池回收為例，若目標回收率為 20%，而該年僅達成 16%，責任業者必須繳交未回收 4% 之回收處理費予環境部，且費用須加成為 115~130%（由回收組織繳交 100% 費用予環境部，另 15~30% 費用則由責任業者繳交予環境部），藉以鼓勵回收及落實相關責任。我國目前資源回收項目雖已達 13 類之多，回收率成果也明顯優於韓國，惟韓國目標回收率之訂定與歐盟各項規範有所契合，為加強鼓勵資源回收再生，建議我國除原每年訂定之全國目標資源回收率外，應可考量未來資源循環利用法施行後，就各項資源物項目訂定其自主回收之目標回收率。

三、再生處理廠之處理區域警示圖案及文字

根據本次考察韓國廢乾電池處理業者 Kobar Limited 之廠區參觀結果，該廠特定處理設備前牆面均張貼醒目之提醒圖案及文字(如各項防護用具配戴、作業注意事項等)，以提醒操作人員注意自身安全，相關作法可作為我國再生處理廠加強環安衛措施及提升再生處理作業之安全性參考。

四、熔煉處理技術

我國目前廢乾電池境內處理僅針對一次筒型錳鋅/鹼錳電池，其餘各類電池均採境外輸出處理，雖然目前已有業者申請二次電池處理，但其採用處理技術為濕式處理，後端所產生之廢液及污泥仍須進一步處理，由韓國廢乾電池處理業 Kobar Limited 之參訪經驗得知，以高溫熔爐處理二次電池可達接近 100% 再生率之效果，惟我國各類二次電池廢棄量有限，投資同類型處理廠恐

有不敷成本之虞。另我國一次筒型錳鋅/鹼錳電池處理現採用破碎分選法，其產出物以二氧化錳為大宗(約占 67~72%)，建議可參考歐、美、日等國經驗，配合廢乾電池檢測，若其汞含量均低於 5ppm，則可採熔煉(即電弧爐煉鋼)方式處理，直接作為煉鋼原料使用，進而提升再生處理效率。

附錄

附錄一、Extended Producer Responsibility System, Ministry of Environment,
Republic of Korea

附錄二、Waste Recycling Management in the Republic of Korea (簡報), Ministry of
Environment, Republic of Korea

附錄三、電池回收 (簡報), 韓國廢乾電池回收組織 KBRA

附錄四、我們與未來環境的約定—廢日光燈回收, 韓國廢照明光源回收組織
KLRA

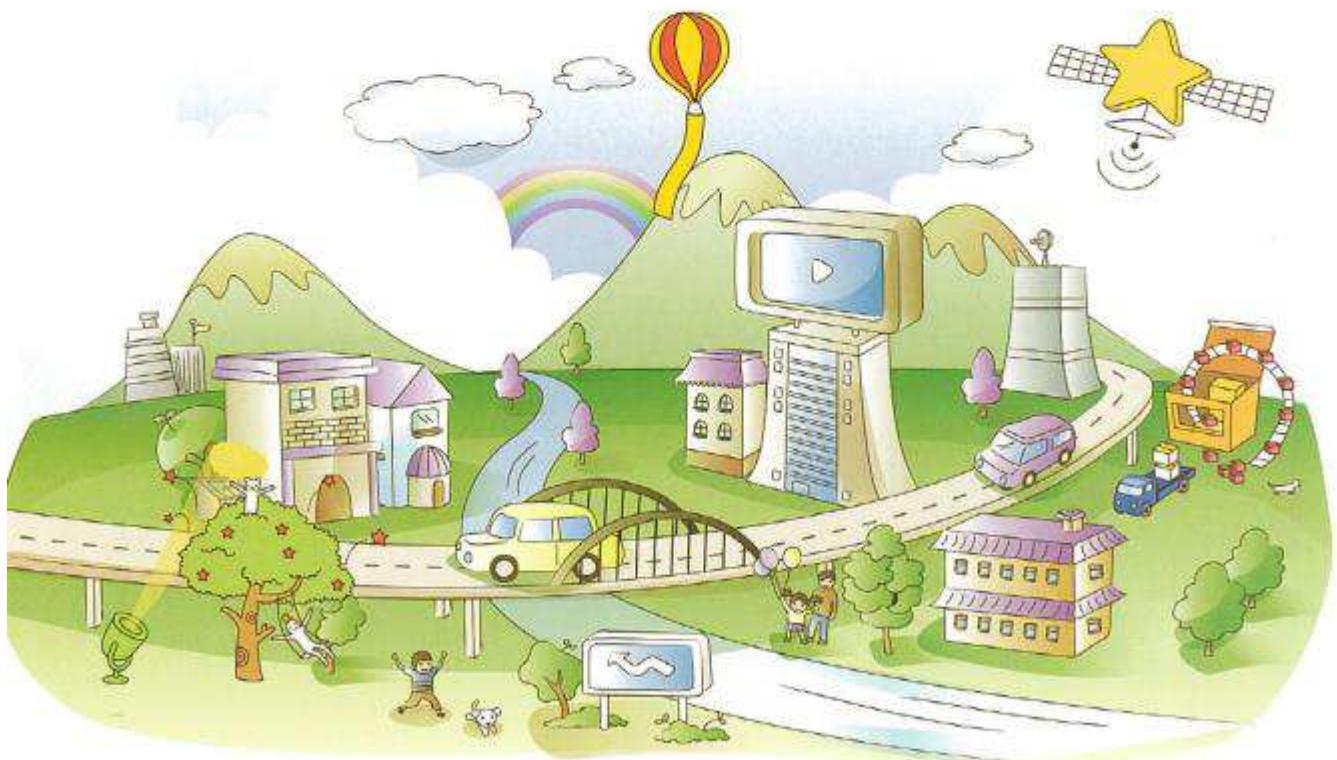
附錄五、Fluorescent Lamp and EPR, KLRA

附錄六、廢日光燈分類回收宣導 DM, KLRA

附錄七、Korea Battery Recycle Limited, Kobar Limited

附錄一、Extended Producer Responsibility
System, Ministry of Environment,
Republic of Korea

EXTENDED PRODUCER RESPONSIBILITY SYSTEM

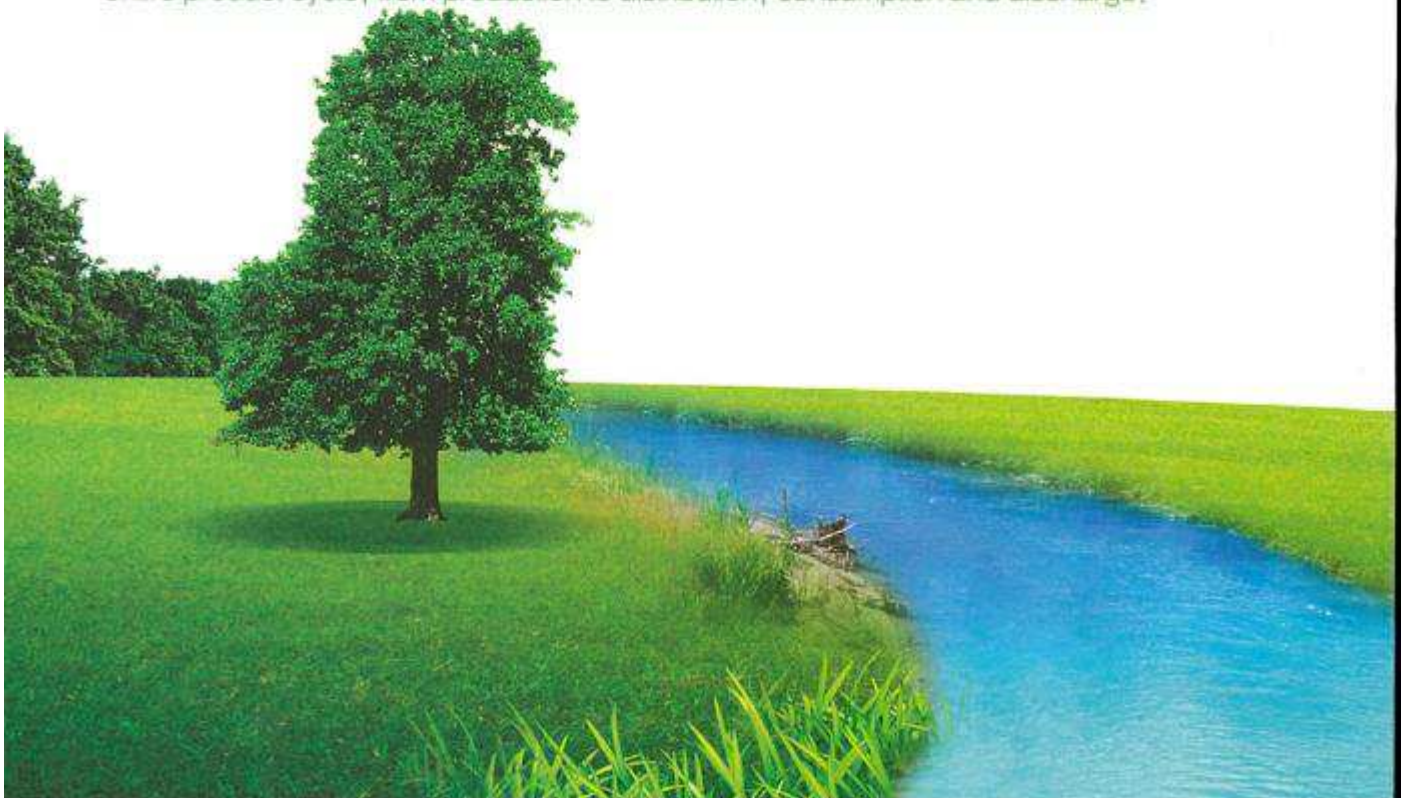




Extended Producer Responsibility

Leading Low-Carbon, Green Growth ,

The Extended Producer Responsibility Program has been operated since 2003, and was implemented under the Act on the Promotion of Saving and Recycling of Resources. It aims to reduce waste at source and improve resource circulation by clearly defining the responsibilities and obligations of the stakeholders (government and producers) in the entire product cycle, from production to distribution, consumption and discharge.





Extended Producer Responsibility System

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Extended Producer Responsibility (EPR) System

What is the EPR System?

EPR is a system wherein the producers of products or producers using packing materials are given the obligation of recycling a certain amount with regard to the products or packing materials concerned. If they do not fulfill their obligation, charges higher than the cost of recycling are imposed.

[Legal Basis : Article 16 of the Act on the Promotion of Resource Savings and Recycling of Resources (Recycling Obligation of Manufacturers, Etc.)]

Producer responsibility

Production → Sales → Consumption → Disposal → Recycling

Previous

Extended

- Although the legal obligation of waste recycling lies in producers, that does not mean the producers are directly responsible for all processes from waste-collection to recycling. Rather, it is a system wherein consumers, local government and central government do their share of duties or roles. Here, a producer with the highest position in terms of product design and selection of packing materials plays a pivotal role in the recycling system.
- EPR is not a completely new concept in Korea; in fact, the system has been implemented since January 1, 2003 following the supplementation and improvement of a deposit system operated since 1992 under the principle of producer responsibility.



Extended Producer Responsibility (EPR) System

Roles of each Entity

Entity	Roles
Consumer	<ul style="list-style-type: none"> ○ Thoroughly separate and discharge recyclable goods – Separate packing materials with separate discharge labels, and conform to the recycling rules of each local government – Separate and discharge plastic films, fluorescent lamps and paper packs – Separate and discharge packing materials of paper products, apparel, and rubber gloves; packages made of films and sheets of electronic and electrical products, disposable bags and shopping bags, from 2010
Producer (Producer-responsible organization)	<ul style="list-style-type: none"> ○ Fulfill the responsibility of recycling (transparent recycling contracts) ○ Monitor recycling process of recyclers(producer-responsible organization) ○ Fulfill separate discharge label responsibility for packing materials
Local Government	<ul style="list-style-type: none"> ○ Separate collection of target items of EPR ○ Establishment of recycling system in accordance with the guidelines for separate collection system
KECO (formerly known as Envico)	<ul style="list-style-type: none"> ○ Accept and approve the sales & import records and the responsibility fulfillment plan of producers ○ Accept and verify recycling-fulfillment result ○ Manage affairs related to EPR operation, including recycling charges ○ Monitor recycling process of recyclers
Ministry of Environment	<ul style="list-style-type: none"> ○ Operate the overall EPR Program, enact and revise regulations ○ Decide the mandated rates of recycling by item ○ Permit the establishment of producer-responsible organization, support and manage local governments and KECO, coordinate and mediate conflicts among entities

Scope of Producer

- Producer refers to the manufacturers and importers of products and packing materials under the EPR Program. Manufacturers include manufacturers of products where the target packing materials are used. (Domestic manufacturers are classified based on the ownership of trademarks, and responsibilities for the same products or packaging materials are exempted.) Importers are defined as producers regardless of the ownership of trademarks.
- Businesses producing products that use packing materials are classified as producers. For OEM situations, the trademark owners who place orders are classified as producers rather than the actual manufacturers.
- For the protection of small businesses, producers are classified according to the volume and the amount of sales or import. The scope is defined by Attachment 4 of the Ordinance of the Act on the Promotion of Saving and Recycling of Resources. Businesses that meet both criteria are classified as producers, and they are responsible for the fulfillment of their responsibility under EPR.

Criteria for Producers of Packaging Materials (Example)

Type of Business	Size of Business	
	Amount of Sales or Import	Volume of Sales or Import of Packing Materials
1. Manufacture and import of packing materials made of paper packs, metal cans or plastic (synthetic resin foam excluded) for food products, agricultural, marine and livestock products, detergents, cosmetic products, medical and pharmaceutical products, health supplement, butane gas, pesticides and germicides, apparel, paper products and rubber gloves, Lubricants	Manufacturers whose previous year revenues are KRW 1 billion or higher, and importers whose previous year revenues are KRW 0.3 billion or higher	Manufacturers whose previous year sales volumes are 4 tons or higher, and importers whose previous year import volumes are 1 ton or higher



Scope of applicable Products and Packing Materials

- As of 2012, the target items of the EPR Program consist of four types of packing materials (paper packs, metal cans, glass bottles and plastics) and five types of products (lubricants, batteries, tires, fluorescent lamps and Styrofoam float for aquaculture).

Item		Packing Materials
EPR	Packing Materials	Iron cans, aluminum cans, glass bottles, paper packs, PET bottles, synthetic resin foam, polystyrene paper, PVC, plastic container trays, plastic film and sheet type materials
	Products	Lubricants, tires, mercury batteries, silver oxide batteries, lithium batteries, nickel-cadmium batteries, manganese batteries, alkali manganese batteries, nickel-hydrogen batteries and fluorescent lamps, Styrofoam float

- Products and packing materials classified as target items of EPR are defined by Article 18 of the Enforcement Ordinance of the Act on the Promotion of Saving and Recycling of Resources.

Item	Products and Packing Materials Classified as Target Items of EPR
Packing materials of food products, agricultural, marine and livestock products, detergents, cosmetic products, medical and pharmaceutical products, health supplement, butane gas, pesticides and germicides, apparel, paper products and rubber gloves, Lubricants	<ul style="list-style-type: none"> a. paper packs (plastic or aluminum foil coated paper packs) b. glass bottles c. metal cans d. packing materials made of plastic (containers, film and sheet type of packing materials and trays included) <p>* Lubricants : plastic packing materials only.</p>
Plastic packing materials of electronic and electrical products	Film and sheet type packing materials and shock-absorbing materials made of synthetic resin foam

Extended Producer Responsibility (EPR) System

Disposable bags and shopping bags		Plastic bags (volume-based waste bags excluded)
Products	Batteries	a. mercury batteries b. silver oxide batteries c. nickel-cadmium batteries d. lithium batteries (primary cell only) e. manganese batteries and alkali manganese batteries f. nickel-hydrogen batteries
	Tires	Tires classified in accordance with the Automobile Management Act and the Act on the Management of Military Supplies, Construction Equipment and Farming Equipment
	Lubricants	Lubricants used for outgoing ships and deep-sea fishing vessels excluded
	Fluorescent lamps	Semi-finished lamps for manufacturing of mercury-containing fluorescent lamps included
	Styrofoam float	Styrofoam float for aquaculture
	Electronic products	(Transferred to the Eco-Assurance System from 2008)

1. "Food Products" refer to food products coded in accordance with Article 14 of the Food Hygiene Act, health functional food products coded in accordance with Article 19 of the Health Functional Food Act, livestock processed products, dairy products and egg products defined by Clauses 8, 9 and 10, Article 2 of the Processing of Livestock Products Act, and drinking mineral water and deep sea water defined by Clauses 3 and 4, Article 3 of the Management Drinking Water Act.
2. "Agricultural, Fisheries and Livestock Products" refer to primary products excluding the food products defined by Clause 1 of the above.
3. "Detergents" refer to soaps and detergents that are classified as toothpastes, soaps or other detergents in accordance with the standard industrial classification of Korea.

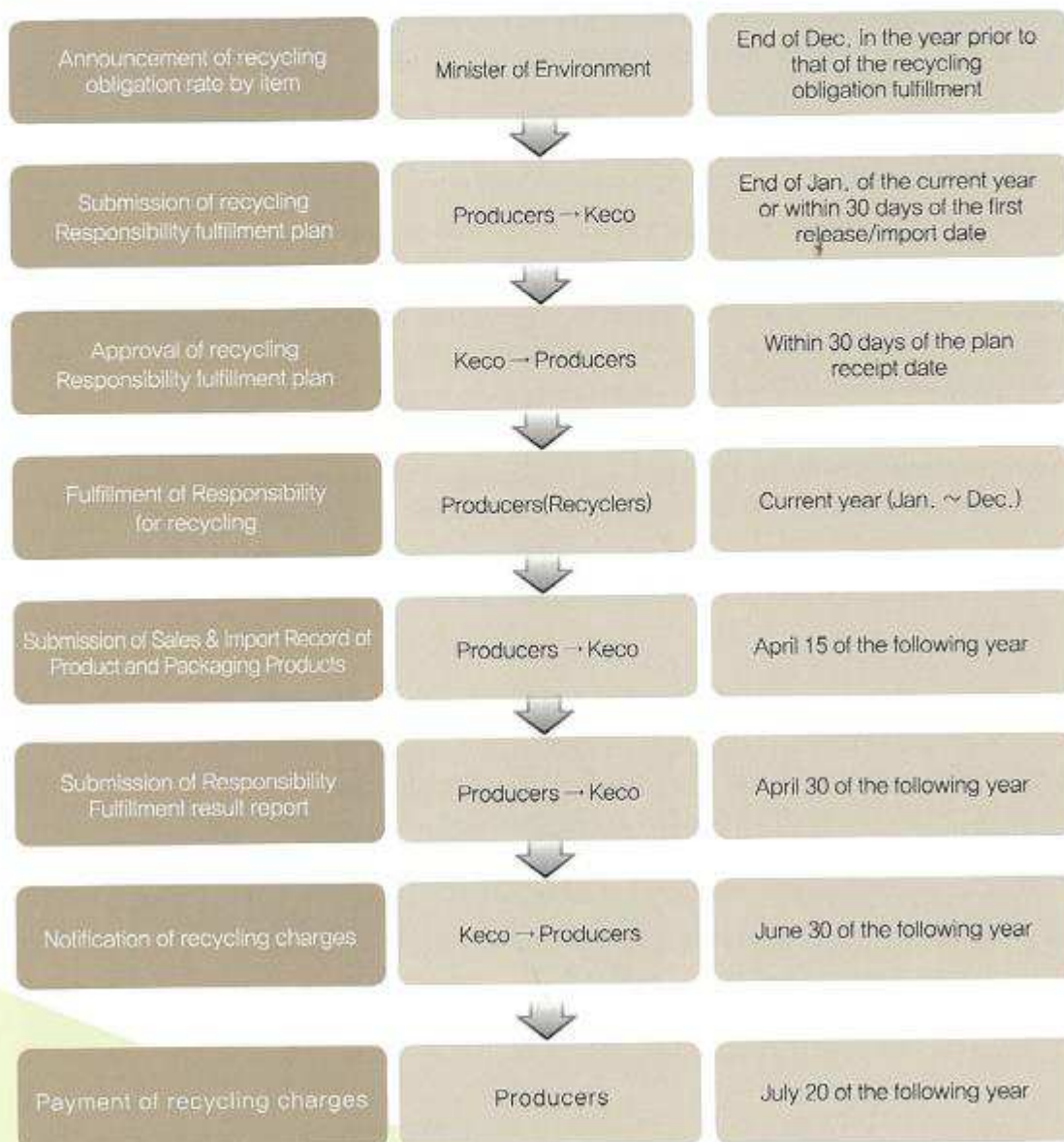
Extended Producer Responsibility (EPR) System

4. "Cosmetic Products" refer to cosmetic products defined by the Cosmetics Act, and shampoos and conditioners for pets.
5. "Medical and Pharmaceutical Products and health supplement" refer to medical and pharmaceutical products and quasi-drugs as defined by the Pharmaceutical Affairs Act. Bayer · ampoule · PTP products whose dose is 30 ml, 30 g or less, products whose dose is 30 ml, 30 g or less and that are not bottle-type products, products for in-vitro diagnosis and products discharged as medical wastes are excluded.
6. "Pesticides and Germicides" refer to pesticides and germicides classified for domestic use in accordance with the standard industrial classification of Korea. Pesticides defined by Article 2 of the Pesticide Management Act, are excluded.
7. "Apparel" refers to clothes and fashion accessories classified as Sewn Apparel, Knitted and Crocheted Apparel and Fashion Accessories in accordance with the standard industrial classification of Korea.
8. "Paper Products" refer to the paper products classified as paper products for hygienic use in accordance with the standard industrial classification of Korea.
9. "Rubber Gloves" refer to the rubber gloves for domestic use among the rubber gloves classified as Rubber Apparel and Other Rubber Products for Hygienic Use in accordance with the standard industrial classification of Korea.
10. "Electrical Products" refer to the electrical appliances, applied audio and video devices, information and office devices and personal computers (monitors and keyboards included) among the electronic appliances that are classified as safety certification targets and voluntary safety test targets in accordance with Clauses 3 and 4, Article 2 of the Electric Appliances Safety Control Act.
11. "Batteries" include batteries that are embedded in or are parts of products.



Work Procedure for the EPR System

EPR Compliance Procedures



Major Details of the System

Setting and Announcement of the Long-Term Recycling Target Rate

- The Minister of Environment announces the long-term recycling target rate every 5 years so that waste collection and recycling can be promoted from production/packaging material production by producers with recycling obligation and distribution to the collection system. The minister reflects it on the recycling obligation rate each year (Legal Basis : Article 17 of the Act on the Promotion of Resource Savings and Recycling and Article 22 of its Enforcement Ordinance).

Criteria for Calculating the Recycling Obligation Rate

(attached Table 5 of the Enforcement Ordinance of the Recycling Promotion Act and attached Table 3 of the Enforcement Ordinance of the Zero Waste Act)

- Formula for calculating the recycling obligation rate
 - Previous year's recycling obligation rate + (Long-term recycling target rate¹⁾ - Recycling rate of the year before the previous one²⁾) x Reflection coefficient of the recycling target rate³⁾ + Adjustment coefficient (-0.05~0.05⁴⁾)

1) Long-term recycling target rate: Recycling target rate announced by the Environment Minister every 5 years to promote the collection and recycling of products and packing materials

2) Recycling rate : Total recycled volume/Total release volume

3) Reflection coefficient of the recycling target rate

Year 1	Year 2	Year 3	Year 4	Year 5
1/5	1/4	1/3	1/2	1

4) Adjustment coefficient is the extent of adjusting the recycling obligation rate considering the recycling factors (-0.05~0.05)

Submission and Approval of Recycling Responsibility Fulfillment Plan

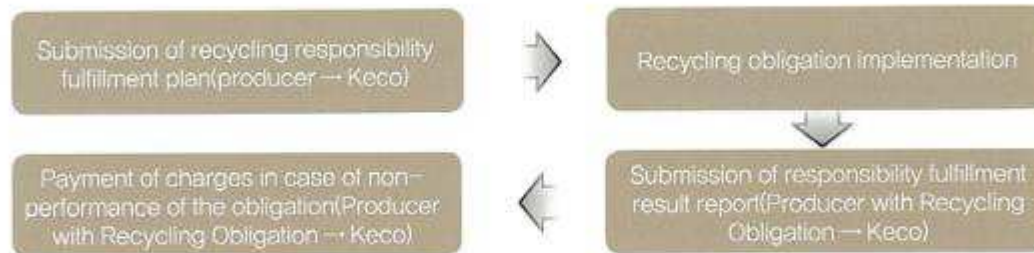
- Submission deadline** : A producer with recycling obligation and a Producer responsible organization submit the plan by the end of January of the relevant year (in case of first release/import in the relevant year , within 30 days of first release/import).
- Documents to submit**
 - ※ In case of non-submission of the plan, up to KRW 1 million fine is imposed.

Major Details of the System

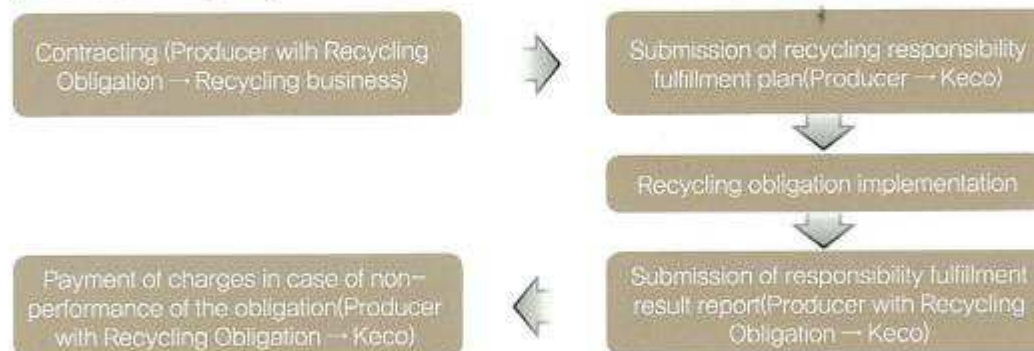
Method of Fulfilling the Recycling Obligation

(Obligation Implementation Method (Article 16 of the Act))

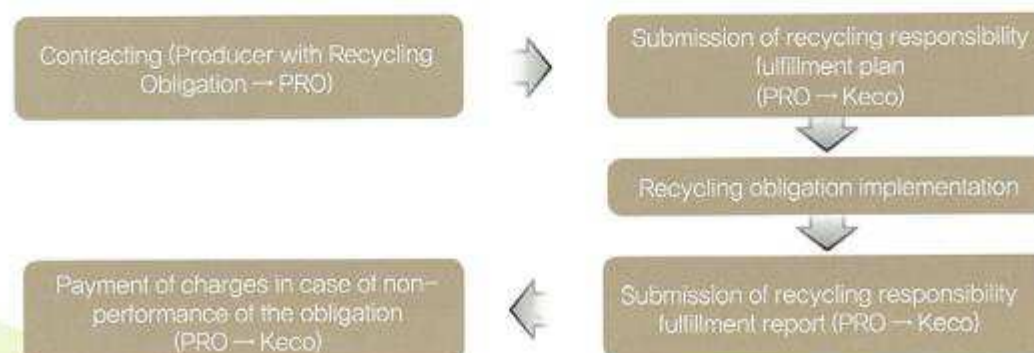
(1) Producer's Own Recycling



(2) Entrusted Recycling



(3) Payment of Share of Expenses for Joining the Producer responsible organization



Submission of Products · Packing Materials Release Outcome

- Submission deadline: Submit data on products · packing materials release outcome by April 15 of following year.
- Documents to submit
 - 1 copy of business registration certificate
 - Document proving product release outcome including a closing accounts report (document proving the import details in case of importing)
 - Basic data for the weight (capacity) calculation of products · packing materials
- ※ Accurate data must be submitted within the period, since the data becomes the basic data for the recycling obligation volume calculation of individual producers with recycling obligation.

Submission of Recycling Responsibility fulfillment Result Report

- Submission deadline :
 - A recycling producer and PRO must submit the recycling implementation result report by April 30 the following year.
 - Documents to submit : 1 copy of collection/recycling management book of products/packing materials targeted for recycling obligation
 - Documents proving the recycling method and standards observance method

Imposition of Recycling Charges

- Impose on the volume for which the recycling obligation has not been fulfilled.
 - The confirmed volume when the difference between the allocated recycling volume and actual recycling volume is checked
 - In case the recycling method and standards are breached by the product/packing material, the volume in breach
- Calculation and imposition
 - Charge 115~130% of the recycling expenses of products/packing materials targeted for recycling obligation with regard to the unrecycled volume.
 - In case of default, 5/100 of additional charges are imposed.

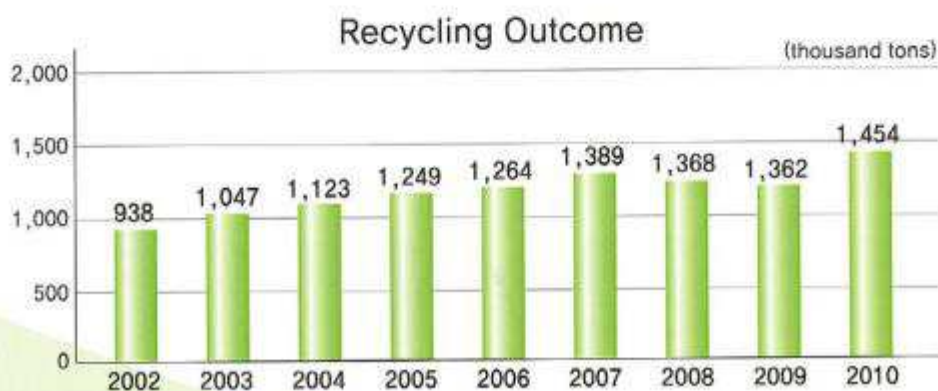
Achievements of the EPR System

Increase in the Number of Producers with Recycling Obligation and Recycling Businesses

- The numbers of producers with recycling obligation and recycling businesses rose from 2,747 and 418 in 2003 to 4,368 and 590 in 2010, respectively. The number of managed producers with recycling obligation per recycling business -- which is directly connected to the economic profits of recycling businesses -- went up from 6.6 in 2003 to 7.4 in 2010. Thus, stable conditions for facilities investment have been prepared.

Category	2003	2004	2005	2006	2007	2008	2009	2010
No. of producers with recycling obligation(A)	2,747	4,315	5,222	5,513	5,703	3,890	4,343	4,386
No. of recycling businesses(B)	418	441	499	566	548	550	560	590
No. of managed producers with recycling obligation per recycling business (C=A/B)	6.6	9.8	10.5	9.7	10.4	7.1	7.8	7.4

- Recycling outcome : With gradual increase each year, 1,454 million tons were recycled in 2010; this is higher by 55.0% (516 thousand tons) compared to 938 thousand tons under the deposit system in 2002.



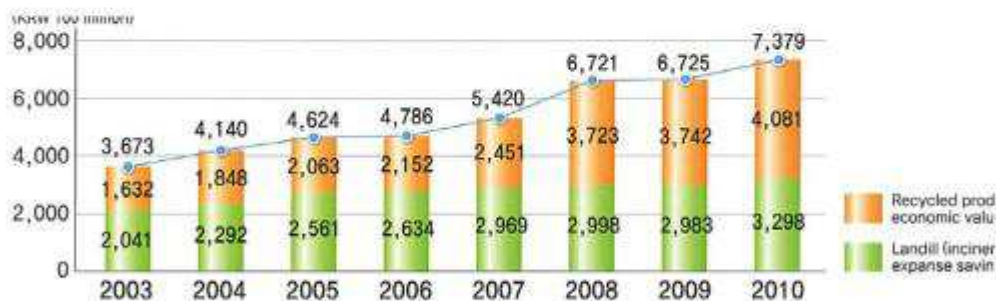
Achievements of the EPR System

- Evaluation of operation achievements

- Economic benefits : KRW 4,347 billion in landfill (incineration) replacement expenses saved, economic value creation from recycled products considering the 10,251 million tons packing materials and products recycled for 8 years through the EPR system implementation
- Expense savings related to landfill replacement (incineration) : KRW 2,178 billion, creation of KRW 2,169 billion in economic value from recycled products

(100 million won)

Category	Total Economic Benefits(A=B+C)	Landfill(incineration) Expense Savings(B)	Recycled Products' Economic Value(C)	Employment Effect (persons)
Total	43,468	21,776	21,692	7,377
2003	3,673	2,041	1,632	685
2004	4,140	2,292	1,848	776
2005	4,624	2,561	2,063	866
2006	4,786	2,634	2,152	904
2007	5,420	2,969	2,451	1,029
2008	6,721	2,998	3,723	1,005
2009	6,725	2,983	3,742	1,010
2010	7,379	3,298	4,081	1,102



- Employment creation : Recycled products generated from the EPR system have economic value of KRW 2,169 billion—they can create about 7,377 jobs for 8 years.



EPR Support Systems

[Separate Discharge Label System]



What is the Separate Discharge Label System?

- Separate Discharge label System is initiated for promotion of sorted collection and recycling of containers and packages. EPR items except products(lubricants, tires, etc) should apply the identification mark which is specially designed to indicate the items' recyclability.



Labeling by Item

Item	Design	Item	Design
Pet		CAN	
Plastic		Paper Pack	
Vinyl		Paper	
		Glass	

Metal Cans



Plastics



PET is generally used for beverage and mineral water bottles.



LDPE, HDPE are generally used for detergent, shampoo containers, and milk bottles.

Plastics



PP is used for the containers of instant noodles, instant rice, etc.



PS is used for the containers of vegetable compartments of refrigerators, transparent containers, yoghurt containers, etc.

Paper pack



The **Other** mark means that two or more plastic materials are used; it is generally used for the packing materials for instant noodles and confectionery.



Paper pack are used for milk packs.

 Method of disposal by Item

• Packing Materials targeted for EPR

Type	Detailed Item	Method of Disposal
A. Paper pack	Paper pack	<ul style="list-style-type: none"> - Empty the contents of the paper pack, rinse with water, if possible, and dispose of it without mixing with general waste paper. ※ In the absence of the waste segregation container for paper packs, dispose of paper packs together with other recyclables.
B. Glass bottle	Beverage bottles, other bottles	<ul style="list-style-type: none"> - After removing the bottle cap, empty the contents of the bottle, and then dispose of the bottle properly. - Do not put foreign substances such as cigarette butts, etc. ※ Glass bottles covered by the deposit refund system are returned to retailers for the corresponding bottle deposit.
C. Metal can	Iron cans, aluminum cans	<ul style="list-style-type: none"> - Remove the contents of a can and compress it. - Remove the plastic lid, etc., inside or outside the can. - Do not put foreign substances such as cigarette butts.
	Other cans (butane gas, insecticide containers, etc.)	<ul style="list-style-type: none"> - After removing the contents of a can by puncturing it, dispose of the can.
D. Plastic	Other containers with packing materials made of PET, PVC, PE, PP, PS, and PSP	<ul style="list-style-type: none"> - Empty the contents of a container, remove the cover made of other material, silver foil, wrap, or attached trademark, and then dispose of it by compressing the container, if possible. - Vinyl (film) should be disposed of by tying it.
	Styrofoam shock-absorbing material	<ul style="list-style-type: none"> - Foamed Styrofoam box for packing agricultural, fishery, and livestock products - Foamed synthetic resin cushioning materials for TV, refrigerator, washing machine, air conditioner, audio, PC, mobile phone handset, printer, photocopier, and facsimile should be returned to product sellers. - Completely remove the contents inside and attached brand mark and eliminate foreign substances if applicable for disposal. - Excluding styrofoam with lots of foreign substances including food or those coated with other materials

• Products targeted for EPR

Type	Detailed Item	Disposal Method
Batteries	Mercury battery, silver oxide battery, nickel/cadmium battery, lithium primary battery, manganese battery, alkali manganese battery, nickel hydrogen battery	<ul style="list-style-type: none"> - Dispose of them by separating the batteries from the products. - Dispose of them through the reverse route including electronic products agents and watch shops. - Place them in the collection containers installed in major strongholds or dispose of them in the designated place on the designated date for battery collection.
Fluorescent lamps	FL, FCL, built-in stabilizer type, FPL, other lighting products containing mercury	<ul style="list-style-type: none"> - Dispose of them in the waste segregation container for fluorescent lamps operated by each local government.
Electronic products	TV, refrigerator, washing machine, air conditioner, computer, audio, mobile phone handset, printer, photocopier, facsimile	<ul style="list-style-type: none"> - Sellers collect them for free upon selling new products. - Dispose of them based on the guidelines for the large-scale waste disposal and collection system improvement. ※ Managed with the eco-assurance system since 2008

[Empty Bottle Deposit System]

What is the Empty Bottle Deposit System?

- To promote the collection and reuse of used bottles, empty container deposit is added to the product price; the deposit is returned to the person returning the empty containers later.
- Items targeted for the deposit system : Products set forth by the Executive Order under Article 15.2.1 of the Act on the Promotion of Resource Savings and Recycling refer to the following products using glass bottles that can be used repeatedly

A. Fermented alcoholic drinks in Article 4.2 of the Liquor Tax Law, distilled alcoholic drinks in Article 4.3 of the same law

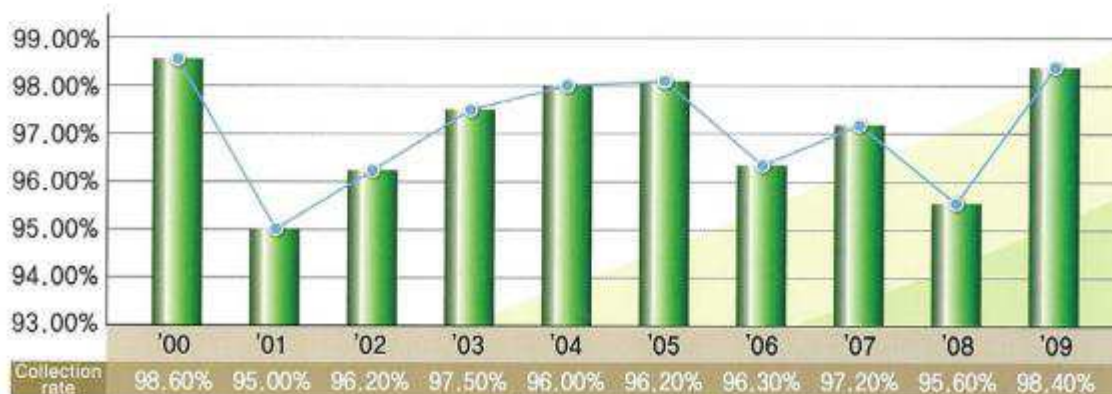
B. Soft drinks

Item	Size	Deposit Amount	Handling Commission (paying 50% or more to retailers)
Alcoholic drinks/ soft drinks	Below 190ml	KRW 20/bottle	KRW 8/bottle
	190ml or more Below 400ml	KRW 40/bottle	KRW 16/bottle
	400ml or more Below 1000ml	KRW 50/bottle	KRW 19/bottle
	1000ml or more	KRW 100~300/bottle	KRW 23/bottle

- Sellers collect the same types of bottles they handle regardless of the original seller and return the deposit to consumers.

* A seller that does not return the deposit is slapped with a fine of up to KRW 3 million.

Status of Empty Bottle Collection Rate





Q&A

Q Do the producers of packaging materials (instant noodles, synthetic resin materials for snacks) become the target for the payment of share of expenses?

A In this case, the recycling obligation is imposed on the producers of instant noodles and snacks, not the packaging material producers.

Q A seller plans (designs) products, and the product producer delivers products to the seller after producing them. In this case, the brand right is owned by the producer. Therefore, which party is the EPR target?

A In the case of OEM, the brand owner shoulders the burden of fulfilling the recycling obligation. When the manufacturer and seller are different, the brand owner becomes the producer with recycling obligation.

Q △△△ Green Vegetable Juice was divided into △△△ Green Vegetable Juice Co., Ltd. for the production part and △△△ Green Vegetable Juice Sales Co., Ltd. for the sales part. Which company should implement EPR?

A When manufacturing foods & beverages and medical supplies bearing brands or trademarks using paper packs, glass bottles, metal cans, and synthetic resin packing materials, the manufacturer must fulfill the recycling obligation. In the case of OEM manufacturing, however, the party placing the order and having the trademark right must fulfill the recycling obligation.

Q When a distribution store sells moisture-containing products or other products by wrapping with wrap using plastic trays to maintain their freshness, and the distribution store's trademark is attached, do these become the target for the recycling obligation? This case does not involve the manufacture of products; instead, a bar code for goods is attached for calculation after packing.

A This case corresponds to the packing materials for foods & beverages and agricultural, fisheries, and livestock products under Article 18 of the Enforcement Ordinance; if the store's own trademark is attached such as the bar code for goods, the trademark right holder must fulfill the recycling obligation.

Q We are considering commissioning the import of carbonated drinks from the US(aluminum can products). Although the products are imported under our name, they are delivered to the purchaser upon import clearance completion. In other words, we are just the import source; the seller of those products is another company in Korea. Which party carries the recycling obligation?

A When importing beverages in aluminum cans, the importer (taxpayer indicated in the import declaration document) must fulfill the recycling obligation. When such obligation is not fulfilled, recycling charges for the unrecycled volume shall be shouldered by the importer.

Online access



EPR online System
<http://www.epr.or.kr>

System Overview

- Online processing of various administrative issues and relevant information provision for efficient law enforcement

Major Processing Jobs

- Submission, review, and approval of documents related to EPR system operation
- FAQ related to laws & regulations and system
- Recycling information provision including statistical data on recycling

Services Provided to Civil Petitioners

- Submission of recycling responsibility fulfillment plans and printing of approvals
- Submission of documents for products targeted for recycling/packaging materials release and import outcome
- Submission of recycling responsibility fulfillment result reports and printing of approvals

Contact Info.

Korea Environment Corporation (Keco)

Environmental Research Complex, Nanjiro 184,
Gyeongseo-dong, Seo-gu, Incheon, Korea

T.82-32-590-4201~4208
F.82-32-590-4219

Producer Responsible Organization

Korea Metal Can Resources Association (target item: metal can) 5-31 Seokwoon-dong, Bundang-gu, Seongnam-si, Gyeonggi-do	T.82-31-706-2930 F.82-31-706-2932
Korea Foam Styrene Recycling Association (target item: foam styrene packing material (excluding PSP)) #404 Hanam Bldg., 44-27 Yido-dong, Yeongdeungpo-gu, Seoul	T.82-2-761-0280~2 F.82-2-761-0283
Korea Glass Bottle Recycling Association (target item: glass bottle) 9F Cheongjin Bldg., 475-22 Bangbae-dong, Seocho-gu, Seoul	T.82-2-3476-1214 F.82-2-3476-1218
Korea Lubricating Oil Industrial Association (target item: lubricating oil) #1001 Woon Venture Town II, 82-29 3-ga, Munrae-dong, Yeongdeungpo-gu, Seoul	T.82-2-2068-6046 F.82-2-2068-6049
Korea Battery Recycling Association (target item: battery) 223 Hwagok-ri, Iljook-myeon, Anseong-si, Gyeonggi-do	T.82-31-671-8312~3 F.82-31-671-8314
Korea Lamp Recycling Association (target item: florescent lamp) #1015 Gangbyeon Hanshin Core Bldg., 350 Mapo-dong, Mapo-gu, Seoul	T.82-2-712-8190 F.82-2-707-0446
Korea Paper Carton Recycling Association (target item: paper carton) 4F Grain Association Bldg., 1031-1 Bangbae-3 dong, Seocho-gu, Seoul	T.82-2-584-1974 F.82-2-584-1976
Korea Tire Manufacturers' Association (target item: waste tire) #1910 Trade Center, 511 Samseong-dong, Gangnam-gu, Seoul	T.82-2-551-1906~7 F.82-2-551-1910
Korea Pet Bottle Recycling Association (target item: PET bottle) 5F Samjung Bldg., 607-13 Yeksam-dong, Gangnam-gu, Seoul	T.82-2-554-4721~3 F.82-2-554-4726
Korea Plastic Recycling Association (target item: plastic packing material (excluding PET bottles and EPS)) #702 Dongwoo International Bldg., 13-4 Yoido-dong, Yeongdeungpo-gu, Seoul	T.82-2-3215-7300 F.82-2-3215-7370~1
Korea Vessel Recycling Association (target item: glass bottle targeted for empty container deposit) 5F Wool Bldg., 1623-2, Seocho-dong, Seocho-gu, Seoul	T.82-2-521-0082 F.82-2-521-4433



Environmental protection is not difficult. Your interest in and practice of environmental protection can lead to the restoration of the polluted environment and conservation of resources. Remember, the environment is an asset that all of us should value and conserve!

mev MINISTRY OF ENVIRONMENT
REPUBLIC OF KOREA

This leaflet is made of environmentally friendly paper that achieved an "Korea Eco-Label" to prevent environmental pollution and to promote resource recycling.

附錄二、Waste Recycling Management in the
Republic of Korea(簡報), Ministry
of Environment, Republic of Korea

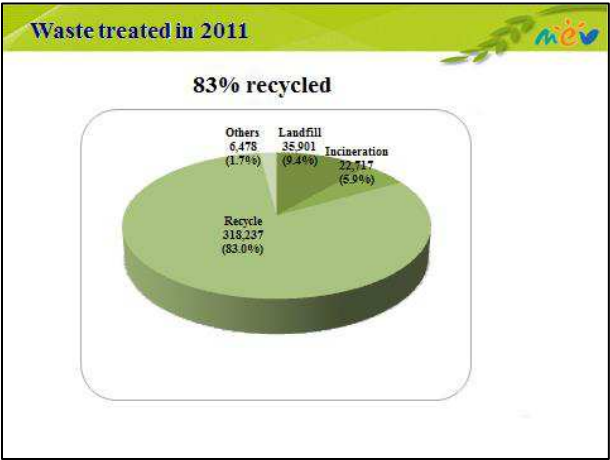
Waste Recycling Management in the Republic of Korea

Ministry of Environment, Republic of Korea

Contents

- Priorities in Waste Treatment
- Waste-related Legislations
- Recycling Regulations and Practices
- Battery Recycling

Priorities in Waste Treatment



Waste-related Legislations

Legislations in the 1980's and 1990's

- Waste Management Act 1986, which is the basic act prescribing categorization of waste, responsibilities of stakeholders and treatment of waste including recycling and safe disposal of waste
- The Act on Saving Resources and Promoting Recycle 1992, which was significantly amended in 2002 to introduce new policy instruments including Extended Producer Responsibility
- The Act on Transboundary Movement and Treatment of Waste of 1992, which is domestic law of the Basel Convention
- The Act on Promoting Construction of Waste Treatment Facilities and Supporting Neighboring Area, 1995

Legislations in the 2000's

- The Act on Establishment and Management of the Sudokwon (Seoul Metropolitan Area) Landfill Corporation in 2000, applied exclusively to the corporation established in 2000 to more systematically operate the Sudokwon landfill which was built in 1991
- The Act on Promoting Recycle of Construction and Demolition Waste, 2003
- The Act on Resource Recirculation of Electric and Electronic Waste and End-of-Life Vehicles in 2007, which is similar to ROHS, WEEE and ELV of EU

Recycling Regulations and Practices

Starting point of Recycling

The volume-based waste fee system

- Makes discharger of non-recyclable garbage pay waste treatment cost in proportion to its amount,
- While the discharge of recyclable waste is free.



Non-recyclable garbage

- Should be put in plastic bag purchased in advance, and discharged at the place and time designated by local governments.
- Discarded bags, 21,413 ton/day, are collected by local government or its contractor, then mostly incinerated or landfilled.



Combustible waste within the garbage bag

- Can be mechanically sorted out and processed to Refuse Derived Fuel at two local governments and the Sudokwon Landfill Corporation under the Ministry of Environment, or
- Recovered to heat energy or electricity at 75 incineration plants operated by local governments.



From Waste to Energy

RDF Plant



Waste Heat Recovery Plant



Food waste

- Should be separated from other waste and discarded in accordance with local regulations.
- Volume-based charge system is applied at urban areas in 2013.



- Since ban on direct landfill from 2005, most of food waste is recycled for feedstuffs, compost or biogas production at public or private facilities.

From Food Waste to Energy



(Food Waste-to-Biogas Plant, Busan)



(Food Leachate-to-Biogas Plant)

(Sewage Sludge-to-Fuel Plant)

Recyclable waste

- Should be separated from other waste, discarded free of charge.
- Collected and sorted by local government or its contractors, then purchased by or supplied free to private recyclers.



collection point



paper can/bottle plastic garbage

What types of waste are recyclable in Korea?

They vary among local governments, but generally,

- paper including disposable cup, clothing, metal scrap
- carton pack, plastic products and packages including film and disposable bag, glass bottle, metal can
- **battery**, tire, **fluorescent lamp**, aquaculture buoy
- electrical and electronic wastes (TV, refrigerator, laundry machine & air conditioner for household, PC, printer, audio, mobile phone, copy & fax machine)
- end-of-life vehicle accommodating less than 9 people, and light truck



Extended Producer Responsibility to promote recycling

- Manufacturers and/or importers are responsible for final recycling of the recyclables (except for paper, clothing, metal scrap).
- The amount to be recycled is annually announced by the MoE (for ELV, the ration is prescribed by the Presidential Decree, more than 85% of weight of vehicle until 2014, 95% after 2015)
- Failure to fulfill allocated recycling ratio leads to charge up to 30% more than the cost for recycling un-recycled amount.
- Manufacturers may establish fraternal association to perform their responsibility, and 11 associations carry out 88% of obliged recycling ratio.

To facilitate recycling, local government should

- Establish and operate centers to facilitate exchange of second-hand goods, and
- Operate public facility to collect, store, sort and pre-treat recyclables.

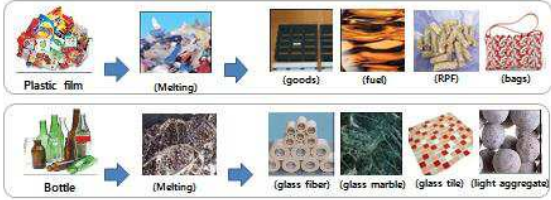


2009. 12. 27



To enhance recyclability of waste, manufacturers should

- Make effort for second-hand parts and products to be easily reused or recycled,
- Mark recyclability indicator on their products and packages after certified by Korea Environment Corporation under the MoE.



Waste should not be wasted, because it's resources!

The monetary value of metals contained in e-waste and ELV is estimated 1.9 billion USD per year.



For further improvement, the MoE is working on;

- Promotion of the use of the heat and gas generated from incinerators and landfill sites,
- Facilitation of bio-gas production from organic waste such as food waste and sewage sludge,
- Building Environment-Energy Complexes across the country,
- Investment of 150 million USD to R&D on metal recycling,
- Continuous campaign for collection of used mobile phones, and so on.

Recycling Complexes & on-line waste exchange market

A variety of recycling enterprises gather at the complexes, the wastes collected from large areas are put into the complexes and efficiently recycled through cooperation among the enterprises.

accumulation of wastes → materials recovered → energy recovered → incineration or landfill



Battery Recycling

Batteries to be recycled by EPR in Korea

Silver Oxide batteries



Alkaline batteries



Tip : For the purpose of protection of environment and human health, production and/or import of mercury batteries have been banned since December 1995 in Korea.

Batteries to be recycled by EPR in Korea

Lithium batteries



Manganese batteries



Batteries to be recycled by EPR in Korea

Nickel-Cadmium batteries



Nickel Metal Hydride batteries

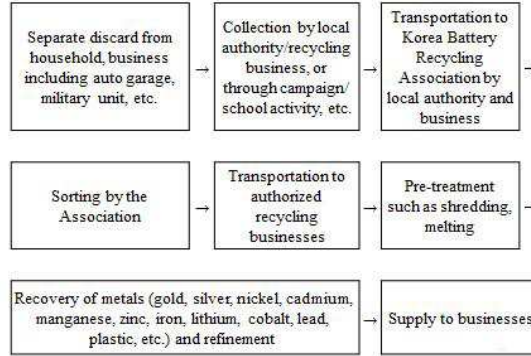


Recycled, but not covered by EPR

Lead-Acid accumulator



Flow chart of battery recycling



Key actor in battery recycling

Key actor in battery recycling

Korea Battery Recycling Association

- Membership : 41 battery manufacturers who are responsible for final recycling of batteries under the with EPR system
- Outcome : 2,068 ton recycled by four battery recyclers in 2011, recovered 20 million USD worth of material



collection box

gathered batteries

sorting



recovered manganese

zinc recovered

iron

Fluorescent lamp Recycling

Fluorescent lamp to be recycled by EPR in Korea



Flow chart of fluorescent lamp recycling



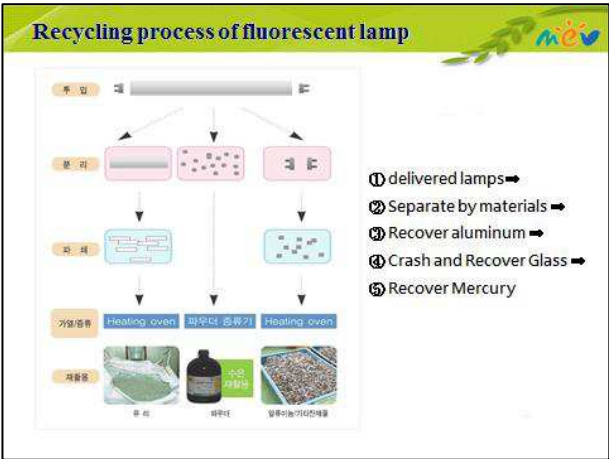
Separate Bin for Fluorescent Lamp



Container for carrying lamps

Gathered lamps


Stacked boxes




Key actor in fluorescent lamp recycling

Korea Lighting Recycling Association

- Membership : 32 battery manufacturers who are responsible for recycling of fluorescent lamps under the EPR system
- Outcome : 4,969tons recycled by four lamp recyclers in 2011.



seperated plastic caps



recovered aluminum



crushed glass

Thank you very much for your interest in the recycling policy and practices in Korea

附錄三、電池回收（簡報），韓國廢乾電池
回收組織 **KBRA**

전지류 재활용

2013년 8월 27일



I. 협회 개요

- ▶ 설립 연도 : 2003. 3. 28(환경부 인가)
- ▶ 대표 자 : 김성찬 (회 장 사 : ㈜로케트전기)
- ▶ 소 재 지 : 경기도 안성시 일죽면 화곡리 223
- ▶ 설립 목적 : 전지 의무생산자의 재활용의무 이행 및 재활용산업 촉진
- ▶ 임직원현황 : 총 6명

협회 회원사 현황		
정회원	준회원	총 회원
42	5	47

II. 전지의 종류

NO.	용 용	기 호	용 용	주 요 전 지
1	알칼리인 전지 Alkaline Battery	LR 계열 R1F22	특징 : 장시간 큰 전류를 필요로 하는 곳에 적합하며 자체 방전이 적어 장기보관이 가능하고, 방전전압에 비해 오래 쓸 수 있음. 용도 : 휴대용 스테레오, 라디오, 게임기, CD플레이어, 소형 카메라, 시계 등	
2	망간산화 전지 Manganese Battery	R 계열 BF22 BA 계열 (BA-30)	특징 : 보편적인 장치로서 전압이 안정화 회복하는 특성이 있어 낮은 전압에서 오래 사용이 가능함. 용도 : 벽시계, 탁상시계, 장난감, 리모컨, 캠코더, 디지털도어락, 가스 자동점화기 등	

II. 전지의 종류

3	산화물전지 Silver Oxide Cell	SR 계열 300D (313, 380)	특징 : 귀금속, 전자계산기의 정밀도로 시작되었으나 최근 기술의 발달로 리튬, 알칼리인 단추형전지 못 대체가 되고 있음. 용도 : 손목시계 등으로 주로 사용되고 있음.	
4	리튬 1차전지 Lithium Battery	CR 계열	특징 : 소형으로 고전압, 긴 사용수명이 장점이다. 용도에 따라 여러 형상 (원통, 사각, 평형 등)으로 만들 수 있으며 사용범위가 넓고 있음. 용도 : 휴대용전자기기, 무전기, 관측시계, 근수용기기, IT장비, 카드단말기 등	

II. 전지의 종류

5	니켈카드뮴 전지 Ni-Cd Battery	Ni-Cd	특징 : 가장 널리 사용되는 충전지로서 1차전지 보다 경제적으로 유리하며, 일반적으로 니카드전지라고 부름. 용도 : 디카, 전동면도기, 무선전화기, 전동공구, 전동공안양, PDA, 산업용기기 등	
6	니켈 수소전지 Ni-Mh Battery	Ni-Mh	특징 : 급속 충전이 가능하며, 보다 큰 전류용량을 가지고 있고 장시간 사용이 가능하다. 카드뮴, 수은 등 공해물질이 없으며 고가의 전자제품에 주로 사용함. 용도 : 노트북 컴퓨터, 휴대용전화, 디카, 캠코더, 통신기기, 헤어보안드레저 등	

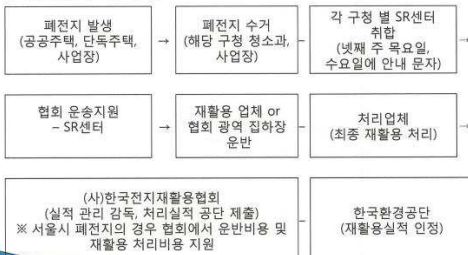
III. 폐전지 주요 업무

1. 주체별 역할

주 체	역 할
소 비 자	- 재활용품의 분리배출 철저 대상품목 : 전지류, 다이어, 윤활유, 전자제품, 형광등, 종이팩, 유리병, 금속캔, 합성수지재질의 포장재, 발포합성수지포장재
지방자치단체	- EPR대상품의 분리수거 업무 철저 - 분리 수거된 폐전지 집하장까지 운송
한국전지 재활용협회(생산자)	- 수집된 폐전지 선별(전지 종류별) 및 처리비 지원 - 재활용 의무 성실 이행 (투명한 재활용 위탁 계약 체결)
정부(환경부)	- 법령 제, 개정 등 전반적인 제도 운영 - 매년 품목별 재활용 의무율 산정 고시 - 제도에 대한 지원, 관리

III. 폐전지 주요 업무

2. 폐전지 수거 체계



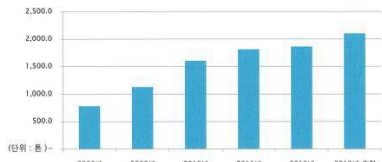
III. 폐전지 주요 업무

3. 품목별 재활용 의무율

품 목	03년	04년	05년	06년	07년	08년	09년	10년	11년	12년	13년
산화물전지	90.0%	90.0%	25.0%	25.0%	30.9%	37.0%	39.0%	42.4%	49.9%	56.0%	56.0%
리튬1차전지	20.0%	29.0%	24.9%	29.3%	38.0%	49.0%	52.0%	57.7%	58.2%	65.0%	65.0%
니켈카드뮴 전지	20.0%	23.0%	24.6%	24.6%	25.7%	29.1%	31.0%	33.3%	38.3%	40.0%	40.0%
망간/알칼리인 전지						20.0%	20.5%	23.6%	19.2%	21.6%	21.6%
니켈수소전지						25.0%	25.0%	28.9%	13.6%	20.3%	20.3%

IV. 전지 수거 현황

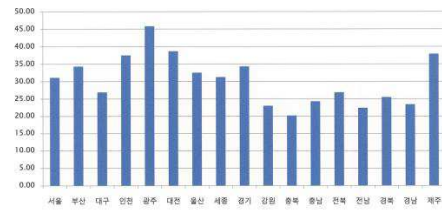
1. 망간/알카라인전지 수거현황



2008년	2009년	2010년	2011년	2012년	2013년 추정
781	1,127	1,602	1,810	1,860	2,100

IV. 전지 수거 현황

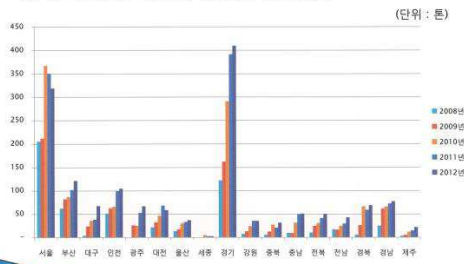
2. 2012년 광역단체별 인구대비 1인당 수거량(g)



※ 2011년 주민등록인구수 적용

IV. 전지 수거 현황

3. 광역단체별 연도별 폐전지 입고현황



V. 홍보 인프라 비교



V. 홍보 인프라 비교



附錄四、我們與未來環境的約定—廢日光燈
回收，韓國廢照明光源回收組織
KLRA

폐형광등 분리수거는 미래 환경과의 약속입니다



(사)한국조명재활용협회
<http://www.recyclinglamp.org>

| 목 차 |



03	1. 형광등과 수은(Mercury)
05	2. 생산자책임재활용제도(EPR)와 형광등
07	3. 재활용 안전처리 시스템
10	4. 재활용의 절차와 방법
13	5. 형광등 재활용의 외국사례
14	6. (사)한국조명재활용협회 안내

1 | 형광등과 수은

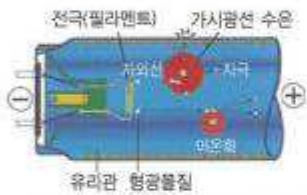


형광등이 개발되어 상용화되기 시작한지 60여년의 역사를 가지고 있습니다. 형광등은 높은 에너지 효율, 빛의 질, 원가 등에서 다른 어떤 광원보다 우수하기 때문에 수명이 짧고 전력소비가 많은 대체용으로 널리 보급되어 있습니다.

그러나 형광등은 발광원리상 수은을 필요로 하며, 아직까지 대체물질이 없기 때문에 수은으로 인한 폐해를 최소화하기 위해서는 수명이 다한 폐형광등을 안전하게 재활용 해야 합니다.



발광원리 및 형광등 수은증기에 관한 해설



형광램프의 발광원리

형광등의 구조는 유리관 내벽에 형광물질이라고 하는 자외선을 가시광선으로 변화시켜주는 분말이 있고, 관의 양끝에는 텅스텐 코일로 만들어진 필라멘트로 설치되어진 전극이 있으며, 이 코일에는 전자방사물질이 도포되어 있다. 관내에는 방전개사를 용이하게 하기 위해 200~400Pascal 압력의 아르곤, 네온, 크립톤 등의 불활성가스와 미량의 수은이 봉입되어 있다. 점등 할 때는 전극음극에 전류를 흘려 예열되고 말 전극 사이에 고전압을 걸어줌으로써 방전된다. 방전에 의하여 전극으로부터 방출된 열전자가 수은증기에 에너지를 주어 수은증기로부터 자외선(253.7nm)이 발생된다. 그 자외선에 의하여 형광물질에 에너지를 주어 여과되어 가시광선을 발생시킨다.



수은(Mercury)은 어떤 물질인가요?



수은(Mercury)에는 무기수은과 유기수은이 있습니다. 수은의 대부분은 무기 수은으로, 형광등, 온도계와 기압계에 많이 사용됩니다. 유기 수은의 한 종류인 메틸 수은은 물고기 체내에서 쌓이기 때문에 바다나 호수가 약간의 수은으로 오염 되더라도 이 물고기들은 쉽게 오염될 수 있습니다. 생물농축의 주범인 수은은 바로 이 메틸 수은입니다.

수은은 우리 주변 환경에서 오랜기간 잔류하는 동안 유기 수은이 무기 수은이 되기도 하고, 반대로 무기수은이 흙과 물 속에서 미생물과 바이러스의 생화학적 작용에 의해 천천히 유기수은으로 바뀌기도 합니다.

또한, 자연상태에서도 바위나 토양이 풍화되거나 화산활동 등에 의해서 대기중으로 수은이 방출되고 널리 퍼져 나갑니다. 석탄, 석유 또는 천연가스 등의 화석연료를 태거나 수은이 함유된 쓰레기를 소각할 때 다량의 수은이 대기 중으로 방출되고 있습니다.





수은(Mercury)은 우리 건강에 어떤 해를 미치나요? ●●●●●●●●●●

수은은 오랜 기간 동안 노출될 경우 영구적으로 뇌, 신장, 여성의 경우 임신에 나쁜 영향을 줄 수 있습니다. 수은 증기를 들이마시게 되면 특히 뇌에 심한 피해를 입게 되고 수은에 오염된 음식을 먹거나 물을 마시는 경우에는 특히 신장에 악영향을 미칩니다. 또한 산모가 유기 수은에 노출되면 태아의 뇌가 손상됩니다. 수은 중독의 영향으로 중추신경계와 신장기능 장애를 들 수 있습니다. 각종 수은 화합물의 독성 및 임상증상은 수은 화합물의 종류에 따라 차이가 있으나, 일반적으로 위장염 증상으로 복통, 메스꺼움, 구토, 때로는 피가 섞인 설사를 일으킵니다. 무기 수은 화합물의 급성 중독 증상은 구기, 구토, 토혈, 구강내적반(赤斑), 저혈압 등이며 심해지면 무뇨(武尿), 혈압 끝에 요독증으로 사망합니다.

만성중독으로는 두통, 현기증, 불면, 기억장애, 운동실조 등이 일어나며 구내염, 치육염, 시신경염, 신경장애 등도 나타납니다. 유기수은 화합물의 급성중독 증상은 전신권태, 식욕부진, 구기, 구갈, 구내염, 청력, 시력, 언어, 보행 등의 장애를 나타내고 경련을 일으키며 단시간 내에 사망합니다. 만성중독 증상으로는 입술, 혀 끝, 사지 등에 이상감각을 느끼고, 일상동작 중의 운동실조, 구심성 시야 협착, 난청, 언어장애, 보행장애, 정신장애 등을 일으킵니다.



받치된 병광통



오염된 종이



기형이상현상



오염된 물고기



기형의 손



어린이 성장장애



대표적인 수은 중독 사고 ●●●●●●●●●●

일본 1950년대 일본 구마모토현 미나마타시에서 발생한 수은중독에 의한 미나마타 병이 처음으로 알려지게 되었고 그후 1965년 니이가타현 이가노강유역의 주민들에게도 수은중독이 발생한 바 있습니다. 1969년 12월 말 미나마타와 니이가타 두 지역의 미나마타병으로 인한 피해자가 모두 총 665명(사망자 333명 포함)이라고 합니다.

이란 이란에서는 1972년 중저소독제 유기수은농약을 사용한 밭물 식품으로 오염된 결과 사망 459명이 발생하였고 중독환자가 6,071명이라고 합니다.



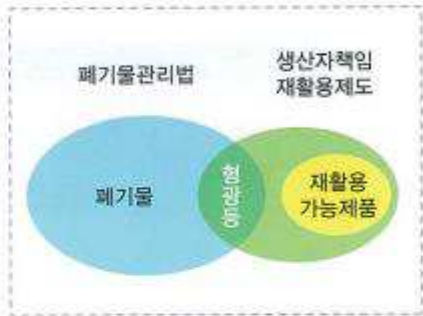
2 | 생산자책임재활용제도 (EPR)와 형광등



EPR(Extended Producer Responsibility)제도는 제품의 설계·생산 단계로부터 폐기물의 발생량을 원천적으로 줄이고 재활용을 확대하여 우리사회를 「자원순환형 사회」로 만들어 나가기 위함입니다.

생산자책임재활용제도는 제품생산자에게 폐기물에 대하여 일정량의 재활용 의무를 부여하여 재활용하게 하고, 이를 이행하지 않을 경우 재활용에 소요되는 비용 이상의 재활용 부과금을 생산자에게 부과하는 제도입니다.

생산자책임재활용제도의 폐형광등은 타 제품과 달리 폐기 시 재활용의 가치가 전혀 없으며 안전처리라는 측면의 환경적인 재활용입니다.



형광등 재활용 재활용 + 안전처리 (재활용 후의 경제성 : 1원)

환경부와 2000년 12월 폐형광등 자발적 협약을 체결, 시범사업기간을 걸쳐 2004년 생산자 책임재활용제도(EPR)의 한 품목으로 도입함에 따라, 각 주체 별 역할분담이 되어 있습니다.

가정배출자	<ul style="list-style-type: none"> 지자체의 분리수거함(분리배출장소)에 안전하게 분리배출
대량사업장(폐기물배출자)	<ul style="list-style-type: none"> 폐지하지 않도록 분리 보관(보관함 구비) 수집·운송·처리를 재활용 가능자(사)한국조명재활용협회에게 위탁(계약을 체결)하여 안전처리 지자체의 지도·점검에 성실히 이행
지자체	<ul style="list-style-type: none"> 가정배출 폐형광등의 수집 및 운반 관할구역 매립·소각장에 사업장 폐형광등 반입을 규제 사업장 적정처리 여부 확인 및 관리·감독
생산자	<ul style="list-style-type: none"> 가정용 폐형광등 처리비용 부담 폐형광등 재활용 시스템(수거·운송·처리 관련) 구축
환경부	<ul style="list-style-type: none"> 폐형광등 재활용 관련 제도전반 지원 관리·감독









재활용이 가능한 형광등의 종류



일반 형광등

구분	형태	설명
직관형 형광램프	 FL	지관유리관의 형태로서 전체 형광등에 차지하는 비율이 가장 높고 사무실이나 상가등에 주로 사용된다. 규격에 따라 10W, 15W, 20W, 32W, 40W 등이 있다.
환형(원형) 형광램프	 FCL	직관형 램프를 동근형으로 구분된 구조로 되어 있으며, 주택의 방에 주로 사용되어 왔으나 콤팩트형으로 대체 되어감에 따라 그 수요는 감소추세에 있다.
안정기 내장형램프	 CFL	콤팩트형 형광등에 시동과 안정관 동작에 필요한 모든 요소를 일체화시키고 부품을 고원할 수 있도록 되어 있는 형광등으로서 백열전구 소켓에 사용할 수 있도록 동일한 베이스가 장착되어 있어 주로 백열전구 대체용이다.
콤팩트형 형광램프	 FPL	유리관을 구부리고 집합하여 콤팩트한 모양으로 다용질한 한쪽 베이스의 형광등으로서 스타터를 내장하는 것과 내장하지 않는 것이 있는데 집합 형태에 따라, P/D/T/W/M/G형 등으로 구분하고 스타터를 내장하지 않는 것은 환형의 대체용으로 그 수요가 폭발적으로 증가하고 있으며 스타터를 내장한 것은 상가등의 DOWN LIGHT용으로 사용된다.

HID램프(High Intensity Discharge, 고광도 방전 램프)



고압나트륨램프(가로등 노란색 빛), 고압 수은등, 메탈 할라이드 램프 등이 있다. 발광을 위한 발광관생성재료와 내열성 유리재료와 외피로 구성되어 있으며, 수은의 사용목적은 발광성을 높이기 위하여 사용하고 있다. 고압나트륨램프, 수은램프의 평균수명은 평균 12,000시간으로 길고, 메탈 할라이드는 이보다 조금 짧은 9,000시간이다.

- 특징 : 1. 램프 하나당 광속이 높아서 대규모 공간의 조명에 적합하다.
 2. 백열전구나 할로겐전구에 비하여 광 효율이 높기 때문에 설치한 시설의 에너지 절약에 기여한다.
 3. 수명이 길기 때문에 유지비, 보수비용의 절감이 가능하다.
 4. 효율 및 연색성 증시에 이르기까지 다양한 램프변화가 있다.

- 용도 : 1. 가로등, 고천정용, 공장, 실내의 경기장 및 체육관
 2. 실험실, 주차장, 터미널, 공항, 광장
 3. 철도역 홀



3 | 재활용 안전처리 시스템

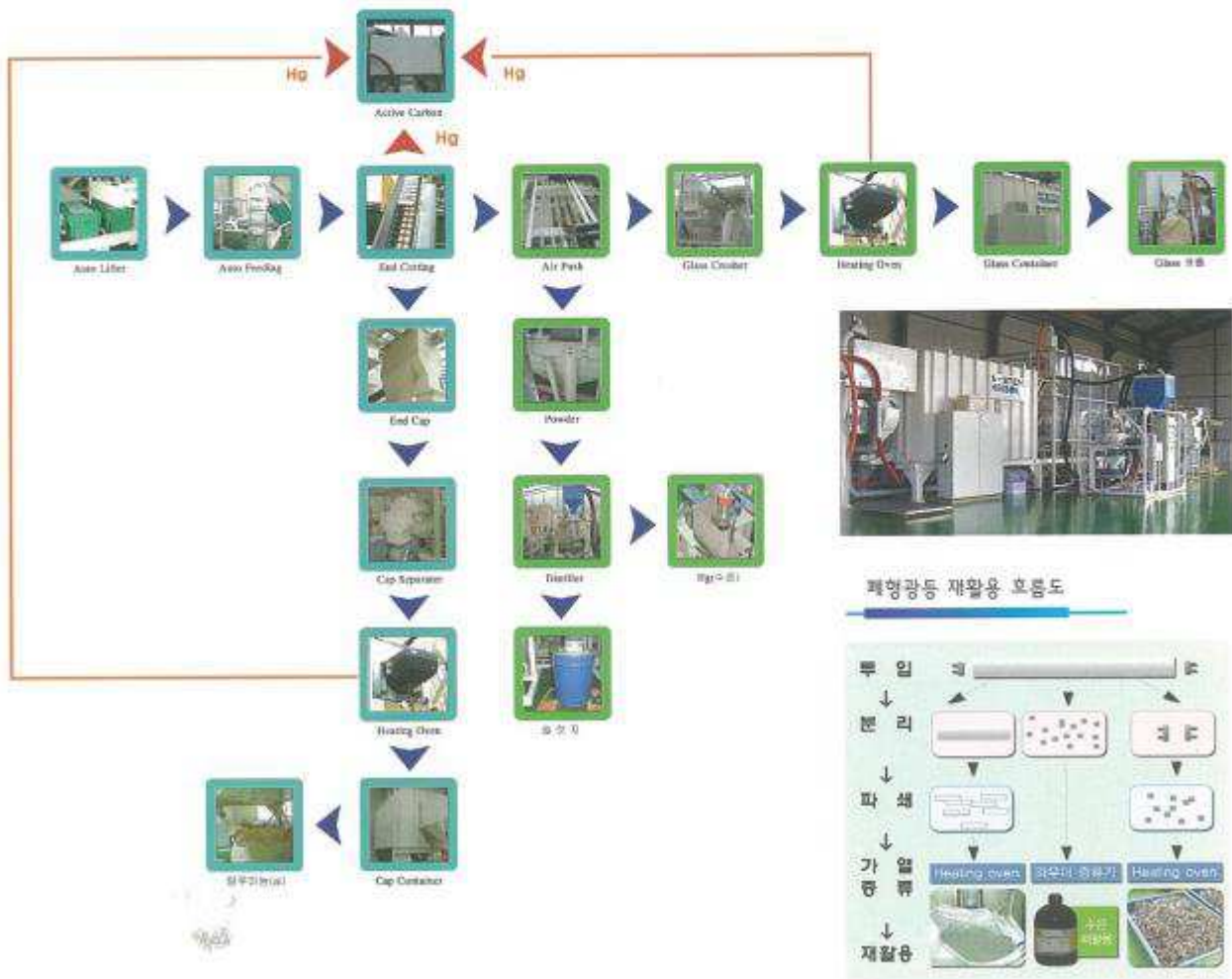


형광등의 구성물질(폐유리, 파우더(형광물질), End-Cap)을 각각의 수은 처리장치에 통과시켜 수은을 포집·처리하고, 설비 내의 증기 수은도 Filter를 통해 흡착 처리하는 등 완벽한 수은을 안전하게 처리할 수 있는 세계 유일의 처리 설비입니다. 수은은 형광등 제조공장으로 유리의 일부는 유리섬유 제작에 사용되나 현재 경제적인 가치는 거의 없는 상태로 형광등은 안전처리 측면의 재활용이라 할 수 있습니다.



시설용량 : 43,200천개/년(독일, Herborn GmbH)

(수도권 : 24,000천개/년, 영남권 : 9,600천개/년, 호남권:9,600천개/년)





재활용 처리시설의 특징



직관형



자동공급장치	동일길이 폐형광등이 담긴 운송용기를 자동공급장치적재대에 올려 놓으면 자동으로 투입
End Cut/Air Push	소다유리 / CAP 분리, 형광파우더 회수
파쇄기	형광파우더가 제거된 투명 유리관 파쇄
Heating Oven	유리 / 금속에 흡착되어 있는 잔류수은 회수 장치
CAP처리기 / 증류기	회수된 형광파우더를 증류 / 수은 회수 / 파우더 잔재물 폐기

기타형(환형, 콤팩트형, 안정기내장형)



공급장치	상승 벨트 컨베이어를 이용하여 처리 SYSTEM에 투입
파쇄기	파쇄기를 통해서 LAMP 파쇄
구성물질 분리	구성물질을 AIRSTREAM으로 분리
Heating Oven	유리, 금속에 흡착되어 있는 잔류수은 제거장치
증류기	회수된 형광 파우더를 증류 / 수은 회수 / 파우더 잔재물 폐기

*기타형 cap은 플라스틱 재질로 금속에 비해 재활용률이 매우 낮음

HID(수은등, 나트륨등, 메탈할라이드 램프 등)



반자동 공급장치	운송용기에서 Turntable Wheel로 자동공급 / 램프가 각각 분리된 후 컨베이어로 이동
분리기	유리제 외피, 발광관, CAP으로 분리
파쇄기	유리제 외피 파쇄 / 재활용, 발광관에는 수은 등 환경유해 물질이 함유되어 있어 파쇄한 후 증류기로 이송
원심분리선별기/증류기	CAP부분으로 부터 금속 / 혼합유리 등으로 분류 / 파쇄된 발광관으로 부터 수은 회수





전국의 폐형광등 재활용 처리 사업장 안내

수도권역 처리설비

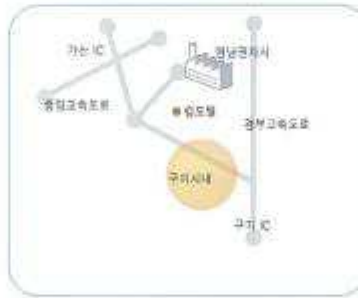
서울, 인천, 경기, 강원, 충남, 충북, 대전



처리장명	수도권지사
전화번호	(031)354-4617
주 소	경기 화성시 양감면 송산리 258-3번지
입지조건	송산공단 내에 위치
건축개요	대지 1,100평, 건물 400평
설비현황	직관형, 기타형, HD형 총 3개 라인
처리능력	직관 : 시간당 5,000개/라인 HD : 시간당 2,500개/라인

영남권역 처리설비

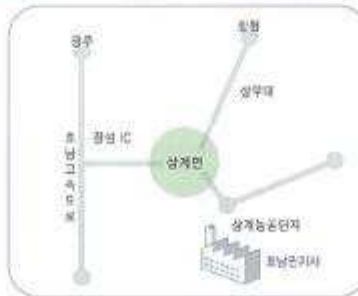
강원, 대구, 경남, 울산, 부산



처리장명	영남권지사
전화번호	(054) 971-0062
주 소	경북 칠곡군 가산면 천평리 1-4
입지조건	국도 4차선 접합
건축개요	건물 940평
설비현황	직관형, 기타형, 공용 1개라인
처리능력	직관형, 기타형 : 시간당 5,000개/라인

호남권역 처리설비

전남, 광주, 전북, 제주



처리장명	호남권지사
전화번호	(061)393-6655
주 소	전남 장성군 삼계면 부성리 788-2
입지조건	국도 2차선 접합
건축개요	공장 1,564평
설비현황	직관형, 기타형, 공용 1개라인
처리능력	직관형, 기타형 : 시간당 5,000개/라인



재활용의 절차와 방법



가정에서 발생하는 폐형광등의 분리배출



가정에서 발생하는 폐형광등의 분리배출 요령



- 형광등이 깨지지 않게 조심하여 내피(포장)를 벗겨서 배출해야 합니다.
- 배출시 각 아파트 관리사무소, 혹은 동사무소에 비치된 폐형광등 수거함에 적절히 배출해야 합니다.



가정용 폐형광등 수거함



가정용 폐형광등 운송 규격함



분리수거함의 잘못된 배치 및 관리





사업장에서 발생하는 폐형광등의 분리배출



연간 1억 5천만개의 폐형광등 중 사업장에서 발생하는 폐형광등은 67%를 차지하고 있습니다. 사업장(빌딩, 공장, 학교, 병원 등 일정규모 이상의 폐기물 배출자)에서 발생하는 폐형광등은 재활용의 적절한 절차를 거쳐 안전하게 재활용 해야 합니다.





절 차	내 용
① 재활용 안내 전용 수거함 배부 (협회→폐기물배출자)	가. 폐기물배출자는 적정처리를 위해 (사)한국조명재활용협회에 폐형광등 적정처리 관련 문의(Tel: 02-712-8190)를 합니다. 나. 협회에서는 재활용 절차를 상세히 안내해드립니다. 다. 회원가입(불량 관리 및 규격함 박스관리 용이)을 위해 체결 및 수거·운송·처리 계약 체결합니다. 라. 계약이 체결되면 협회에서는 폐기물배출자가 요청하는 곳으로 해당 규격함을 택배로 보내드립니다. (수거함 및 수거함 배송비는 배출자 부담)
② 깨지지 않게 보관(폐기물배출자)	가. 협회에서 구비한 폐형광등 사업장 규격함 폐형광등 발생시 규격별로 (직관용 직관대로, 환형용 환형대로) 내태(포장)를 벗겨 깨지지 않도록 보관합니다.
③ 수거물량 접수 및 신청 (폐기물배출자→협회)	가. 구비한 박스에 일정량이 모이면 협회로 연락하여 폐형광등 수거를 요청합니다. 나. 협회에서는 수거일을 확정하여 사업장에 통보합니다.
④ 폐형광등(전용수거함) 수거·운송	가. 일정이 확정되기 전 주 협회에서는 폐기물배출자에게 처리 가능한지의 여부를 다시 한번 확인합니다. 나. 수거 당일 폐형광등 전용수거·운송차량이 출/입 가능한 장소까지 수거함 이송하여 원활한 수거·운송 협조합니다. (반박스를 가지고 가서 폐형광등이 다 찬 박스와 교체하는 방식으로 재활용 공장으로 반입)
⑤ 폐형광등 처리 확인 및 처리비 납부	가. 수거일 폐기물배출자는 증명서(영/영세표)를 받습니다. 나. 영세표에 확인된 수량만큼 세금 계산서를 통해 폐기물 배출자에게 비용을 청구합니다. (협회→폐기물배출자)





사업장 폐형광등 재활용 시 주의사항



-  깨지지 않게 내피를 벗겨 규격별로 보관합니다.
-  반드시 깨지지 않도록 보관용기(보관장소)를 구비하여야 합니다.



사업장 재활용 전용 규격함



5 | 폐형광등 재활용의 외국사례

폐형광등 분리수거는
미래 환경과의 약속입니다

일본	<ul style="list-style-type: none"> 일반폐기물 : 지자체(분리·수집·보관)→운반위탁업자(운송)→처리업체 산업폐기물 : 사업자(보관)→수집운반업자(운송)→처리업체 처리율 : 8%(출처 : 사단법인 일본전구공협회, 2000)
미국	<ul style="list-style-type: none"> 각 주의 연방의 법률에서 폐램프의 수집 책임 및 재활용 처리율 : 10%(일반적으로 각 주의 다양한 여건에 따라 다르게 추산됨)
캐나다	<ul style="list-style-type: none"> 가정폐기물 : HHW(Household hazardous Waste)수거장을 통한 시민들의 자발적 반납 또는 수거대행 프로그램 산업폐기물 : 상업지역의 경우 Laidlaw시 같은 개인회사를 통한 회수방법 처리율 : 가정은 거의 미비하나, 사업장은 주/시정부의 감시가 까다로우 구입한 형광등의 처리가 약 65~85%로 상당히 높음.(출처 : 한국무역협회 조사자료, 2001)
호주	<ul style="list-style-type: none"> 형광등을 산업폐기물로 분류하고 있으며, 발생량 45~50백만개임. 처리율 : 20%(출처 : 한국무역협회 조사자료, 2001)
오스트리아	<ul style="list-style-type: none"> 발생량에 대한 정확한 통계가 없으며, 백열등이나 에너지 절약형 램프를 사용, 형광등은 사무실이나 산업시설에 사용 처리율 : 발생대비 처리율을 파악할 수 없으며 수거량은 연간 40만개(출처 : 한국무역협회 조사자료, 2001)
프랑스	<ul style="list-style-type: none"> 시장규모는 약 50백만개 정도로 추정, EU의 규제를 받고 있어 수은함유폐기물에 대한 소각을 금지하고 있음. 처리율 : 10%(출처 : 한국무역협회 조사자료, 2001)
스웨덴	<ul style="list-style-type: none"> 형광등의 시장규모는 약 14백만개 (저효율 램프 포함) 회수율 : 약 60%, 8.4백만개(출처 : 한국무역협회 조사자료, 2001)
독일	<ul style="list-style-type: none"> 폐형광등은 1996년 생산자책임재활용제도를 실시하기 위해 시행된 순환경제기본법의 전기·전자 폐기물에 관한 명령의 품목에 포함 처리율 : 약 30%
대만	<ul style="list-style-type: none"> 사업체에서 20% 배출, 가정에서 80% 배출함. 처리율 : 8% 형광등 처리업체를 통해 처리, 약 92%는 매립장으로 반입

3 | 사단법인 한국조명재활용협회 안내

형광등은 높은 에너지효율, 빛의 질, 원가 등에서 다른 어떤 광원보다 우수하기 때문에 수명이 짧고 전력소비가 많은 백열전구 대체용으로 널리 보급되고 있습니다

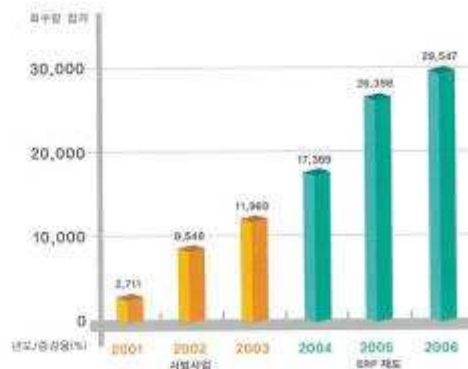
발광원리상 수은의 사용이 불가피하여 반드시 재활용해야하는 품목으로 생산자를 중심으로 안전처리에 대한 깊은 고민 끝에 '00년 6월 형광등협회가 설립되었고 '00년 11월 형광등 재활용에 관한 생산자 자발적 협약을 체결하면서 3여년간의 수도권 시범사업 실시하였습니다. 시범사업을 바친 '04년부터 생산자책임재활용제도에 편입하여 전국적인 폐형광등 분리수거 체계가 구축되었고 현재 시범사업 이후 10배 이상이 증가된 양이 재활용되고 있습니다.

이제 환경문제는 한 개인이나 지역의 문제가 아닌 범세계적인 현안입니다. 또한 환경문제는 국민의 삶의 질과 직접 연관되어 있을 뿐만 아니라 경제적인 측면에서도 큰 비중을 차지합니다. 선진국에서도 국가 정책이 단순히 경제적 효율성만 추구하는 것이 아니라 환경과 경제적 효율성의 공존을 모색하고 있습니다.

저희 한국조명재활용협회에서는 형광등 내의 완벽한 수은회수율 및 회수 처리 시스템의 확대구축 및 안정화를 통해 무단으로 폐기되는 많은 형광등으로 인한 환경오염의 피해를 최소화하도록 최선의 노력을 다하겠습니다.

- (사)한국형광등재활용협회 설립('00.06.12)
- 폐형광등생산자재활용에관한자발적협약 체결('00.11.06)
- 주요협약내용 : 「폐형광등의 전국적인 회수·처리체계를 구축」 등
폐형광등 생산자 재활용 제도가 원활히 추진될 수 있도록 노력
- 형광등 분리수거 수도권 시범사업 실시('01.04~'03.12)
- 환경부 폐형광등 재활용 공제조합 설립인가('03.12.18)
- 자원의 절약과 재활용촉진에관한법률 제28조 및 동법시행규칙 제21조 미거
- 생산자책임재활용제도(EPR)상의 형광등 품목 편입('04.01)
- 협회 명칭 변경('04.03)
- (사)한국형광등재활용협회→한국조명재활용협회
- 전국적인 폐형광등 분리수거 체계 구축('04.10)

구분	회수량	
	합 계	전년대비증감률(%)
2001	2,711	-
2002	9,548	1.215.2%
2003	11,960	1.40%
2004	17,309	1.45.1%
2005	26,398	1.52%
2006	29,547	1.12%



회원사 현황

폐형광등 분리수거는
미래 환경과의 약속입니다

번호	회원명	주소
1	지이삼성조명사	서울시 강남구 삼성동 71-3 지이타워3층
2	(주)에스이	인천광역시 남동구 노원동 428-7번지 20B-8L
3	우리조명사	경기도 안산시 단원구 성곡동 636-3번지
4	(주)엘익	서울 서초구 서초동 1445-3 국제전자센터10,23층
5	(주)기림	경기도 부천시 원미구 도당동 169-12번지
6	코스모스전기(주)	경기도 양주시 용정동 208-1번지
7	쌍사신협(주)	인천광역시 계양구 학전동 614-22층
8	금호전기(주)	경기도 화성시 동탄면 집자리 211-1
9	(주)필립스전자	서울시 용산구 비례동 200-199번지
10	삼진(주)	대구광역시 남구 대명동 1675-29
11	(주)한승	충북 청원군 부용면 갈산리 388번지
12	두영전자(주)	(우편주소)충남 당진군 당진읍 사곡리 81
13	위세출판광	경기도 화성시 잠안면 잠안리 1330-24
14	(주)오스탈코리아	서울시 강남구 삼성동 150-30 매성빌딩 3층
15	라일산광주	경기도 부천시 원미구 역대동 193 부천테크노파크402-704호
16	에스코조명(주)	경기도 고양시 일산 서구 덕아동 1085-35
17	도모코리아	경기도 광명시 노온사동 378-7
18	남영전기	강서구 들izon 652-12 송원B07
19	무림실업(주)	인천광역시 서구 가좌동 469-10번지
20	서울라이팅	부산광역시 강서구 감동동 498-14
21	(주)대한하이리트	경기도 김포시 차기동 1177번지
22	세일전기(주)	부산광역시 중구 창선동 2가 45번지
23	세성전기	경기도 화성시 비봉면 구포리 905-35
24	부영조명(주)	서울시 강남구 역삼동 827-20 도영빌딩 4층
25	(주)엘기시	인천광역시 부평구 청천2동 421-1번지
26	(주)대한일공	서울시 강서구 공항동 1370 (한경빌)
27	(주)선일일렉트	서울시 노원구 하계동 250-3 하계테크노타운 A동 501호
28	(주)영주전기	인천시 계양구 서운동 149-68
29	(주)오렉스	경기도 고양시 일산 동구 장항동 757 경기벤처빌딩 207호
30	(주)이온클러닝	서울특별시 서초구 서초동 1376-1 외교센터빌딩 801호
31	(주)이온라이트	서울특별시 서초구 서초동 1376-1 외교센터빌딩 801호
32	(주)우중	서울시 양천구 신장동 952-5 제습빌딩 5층
33	한국조명기산협(주)	서울 금천구 가산동 371-7
34	(주)금동테크	서울 마포구 토정동 6-97 1층
35	삼성테크코워	서울 강남구 역삼동 701-2 삼성개발빌딩
36	에스비에스코리아	서울 중구 을지로5가 40-3 흥원원공원 지하 143호
37	(주)필룩스	경기도 양주시 광적면 석우리 624-8
38	광영전기(주)	경기도 성남시 중원구 상대원동 333-9
39	파나소닉전기코리아(주)	서울시 강남구 대치동 998-1 미래에셋타워 10층
40	신세게마티(주)	서울시 송파구 신천동 11-10 아이스피이스 4층
41	남버스조명	전북 정읍시 정명동 169-1 2층
42	(주)박조명산업	경기도 남양주시 진건읍 배양리 663-1
43	(주)프리즘	경기도 부천시 원미 출역동 152-10

우리 생활의 편리한 형광등
재활용하여 더욱 유익한 생활을 만듭시다



 **KLRA**
Korea Lighting Recycling Association
한국조명재활용협회

서울시 마포구 마포동 350번지 강변한신코아빌딩 1015호
TEL : 02.712.8190-1
FAX : 02.707.0446
<http://www.recyclinglamp.org>

附錄五、Fluorescent Lamp and EPR, KLRA

KLRA

Fluorescent Lamp and EPR





- EPR(Extended Producer Responsibility) system is for reduce waste from design and production level, and encourage recycling, making this society to 'Resource circulation society'.
- End-of-life fluorescent lamp is waste that contains mercury that is harmful, because of that it has to be separated safely.
- On EPR system, used fluorescent lamp recycling is different from other recycling, for it is recycled for safe treatment, not for economical reason.
- Content of Fluorescent lamp

	Straight type		Round type
Watt	40W	20W	30W
Glass tube	230g	110g	160 - 170g
Fluorescent powder	5-7g	2.5 - 3.5 g	2-3g
Electrode	6-7g		
Filled gas	5-8mg	2.5-4mg	2-3.5mg
Mercury	10-50mg(average 25mg~30mg)		
Metal parts	5-6g		15g
Adhesives on metal	4-5g		-
Weight per unit	255g	130g	190g
	diameter	32.5mm	32mm
	length	1,198mm	230mm

Roles

Household	<ul style="list-style-type: none">· Disposal on separate collection box of local government is mandated.
Business site	<ul style="list-style-type: none">· Storage without breaking(equip storage box)· Collection, transportation, recycling is commisioned to recyclers. ⇒ 1,000,000 won is fined when violated· Must receive guidance and inspection of local government.
Local government	<ul style="list-style-type: none">· Expand separate collection box for households.· Collection and transportation of fluorescent lamps from household.· Restrict fluorescent lamps going to incineration plant or landfill site.· Supervision and inspection of business site.· Record and inspection report to minister of ministry of environment annually.· Announce record of local released/recycled amount to press.
Producer	<ul style="list-style-type: none">· Pay recycling cost of fluorescent lamp from household.· Establish fluorescent lamp recycling system(about collection, transportation, recycling).
Ministry of Environment	<ul style="list-style-type: none">· Support system concerned with fluorescent lamp recycling.· Management, supervision.

Type of fluorescent lamp that can be recycled

FL		straight shape
FCL		round shape
CFL		incandescent light bulb shape, contains inverter
FPL		flat shape

Used Fluorescent lamp from household

- Target: Detached house, Apartment
- How to separate: Discharge into collection box from local government
- Designate fluorescent lamp collection day by local government
- Supply and expand of separate collection box

Guideline for separate collection of fluorescent lamp

House, Apartment 33% of total amount of
fluorescent lamp



Gathered at Local government storage area



Discharged to Apartment office, village office,
etc.



Transported by Local government



Recycle process Korea Lamp Recycling
Corporation

Fluorescent Lamp Recycling Status

(unit : 1000)

Year	2004	2005	2006	2007	2008	2009	2010	2011
Seoul	8,666	10,171	11,119	8,809	10,231	10,894	11,303	12,080
Gyeonggi	4,612	6,931	6,904	6,062	6,436	6,627	7,458	7,766
Incheon	1,485	1,665	2,006	1,807	1,907	2,026	2,032	2,454
Daejeon	463	1,010	1,370	1,174	1,631	1,649	1,817	2,082
Daegu	108	478	355	538	415	634	680	677
Ulsan	124	288	510	598	737	939	866	740
Busan	755	1,855	1,677	1,826	2,169	2,234	2,425	2,514
Chungcheongbuk	149	556	741	757	703	909	888	1,019
Chungcheongnam	134	495	740	756	833	883	1,167	1,173
Jeollabuk	28	356	1,020	1,352	1,238	1,251	1,259	1,460
Jeollanam	162	460	686	664	760	613	759	804
Gyeongsangbuk	45	238	535	675	899	945	980	1,149
Gyeongsangnam	411	1,305	1,140	1,288	1,456	1,486	1,639	1,625
Gwangju	103	206	215	253	389	530	933	1,176
Jeju	31	117	184	252	271	286	279	399
Gangwon	84	258	337	465	627	741	778	826
Total	17,369	26,398	29,546	27,282	30,711	32,654	35,269	37,951

Fluorescent Lamp Recycling Plant

- Components of fluorescent lamp (glass, powder, end-cap) get through to process that collects mercury. It is perfect system that collects all of mercury in fluorescent lamp. Some of recycled glass used in manufacture of glass fiber, but most of recycled glass is not economical. The most important aspects of recycling is for safety.



☪ Equipment Specification

품 명	용 량	비 고
Lamp Auto Feeding System	5,000/HR	Put container that contains 1000 of fluorescent lamp into system, and it process automatically to packing process.
End Cap processor	300kg/HR	Process End Cap to aluminum and leftovers
Heating Device	1,500kg/HR	equipment removing crushed glass, mercury absorbed in End Cap
Distiller	100kg/HR	Designed to process continuously.
Hg & Dust Detection System	PPM	Monitoring density of mercury of plant and other important part.
HID lamp process system	2,500/HR	Same as fluorescent lamp processing system able to auto feeding and absorbing mercury.



☪ Fluorescent lamp recycling company

Korea Lamp Recycling Corporation

Kyeonggi-do, Hwaseong-si, Yanggam-myeon, Songsan-ri 258-3

Tel) 031.354.4617. Fax) 031.354.4619

☉ Fluorescent lamp recycle facility

1. capital area



name	capital area branch
construction	site 3,636m ² , building 1,322m ²
equipment	straight type 2 line HID type 1 line
capacity	straight type 5,000/h HID type 2,500/h

2. Yeongnam area



name	Yeongnam area branch
construction	site 3,107m ²
equipment	straight and other type 1 line
capacity	straight and other type : 5,000/h

3. Honam area



name	Honam area branch
construction	factory 5,180m ²
equipment	straight and other type 1 line
capacity	straight and other type : 5,000/h

附錄六、廢日光燈分類回收宣導 DM, KLRA

폐형광등 분리배출

우리 환경을 지킵니다!!

형광등은 왜 적정처리를 하여야 하는가요?


형광등 속에는 인체에 유해한 중금속(수은)이 함유되어 있어 버릴 때 깨어지게 되면 수은 이 대기중으로 날아가거나 토양으로 스며들어 환경을 오염시키게 됩니다. 심지어 깨어지는 순간 사람이 마시게 되면 몸속에서 배출되지 않고 신경계통을 마비시키거나 신장 및 장기의 손상을 가져오며 특히 임산부는 태아에게 영향을 줄 수도 있습니다. 그러므로 폐 형광등은 절대 깨트리지 말고 반드시 가까운 곳에 비치된 전용수거함에 분리배출하셔야 합니다.

분리배출 요령은?

- ❑ 깨지 말고 반드시 전용수거함에 모양별로 넣어주세요.
- ❑ 걸피는 벗겨서 형광등만 넣어 주세요.
- ❑ 이물질이 들어가면 재활용이 불가능해집니다.

분리배출 요령은?



 사단법인 한국조명재활용협회

www.recyclinglamp.org

서울시 마포구 마포동 350번지 강변한신코아빌딩 1015호

TEL : 02)712-8199 FAX : 02)707-0446

분리수거된 폐형광등 처리과정은?

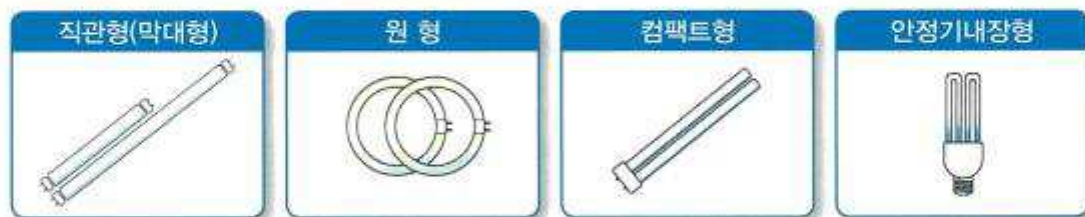
1 가정용



2 사업장



재활용가능 형광등의 종류



처리공장 시설 현황

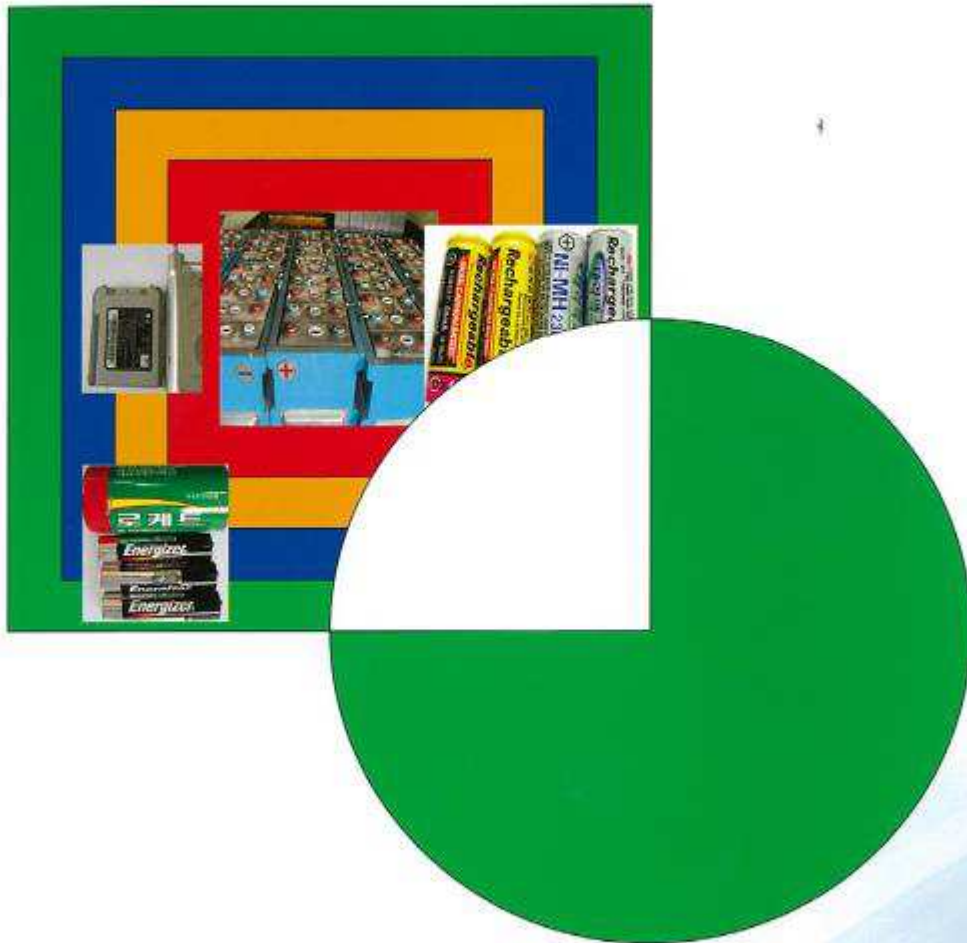


附錄七、Korea Battery Recycle Limited，
Kobar Limited



KOREA BATTERY RECYCLE Limited

Environmentally sound green recycling system of
battery wastes from all over the world



KOBAR Limited

A modernized Pyrometallurgical Process for the Recycling of Ni-Cd and Ni-MH Battery Wastes

Battery Scrap & Wastes

Ni-Cd battery consist of nickel, iron, cadmium, plastic and electrolyte.

The metals to be recovered are nickel, iron, and cadmium.

It is very difficult and uneconomical to separate these metals mechanically and/or chemically.

The method We employ is distill the cadmium, other Hazardous metals, Electrolyte, Plastic and All other Organic Materials.

The remaining residue after distillation contains pure nickel and iron.

Dismantling / Sorting / Crushing

Per-distilled process industrial batteries are first drained and dismantled into cell cases, posts, plates and opened by roll-crushers.



Ni-Cd Industrial Battery



Ni-Cd & Ni-MH Battery



Roll - Crushers

A modernized Pyrometallurgical Process for the Recycling of Ni-Cd and Ni-MH Battery Wastes

FURNACE

The cadmium containing scraps generated by battery producers and/or consumers are charged into furnaces in specially designed furnaces.

The furnace is heated up to very high temperature under reduced pressure.

The vapor is changed into metallic cadmium in the condenser.

The gas and cadmium dust generated in the furnace are collected efficiently by using a wet scrubber.



Furnace

Fe-Ni INGOT

The ferro and the nickel metals are melted by a special designed furnaces to make Ferron-Nickel alloys for the stainless steel application.



Fe-Ni Scrap

Cd STICK

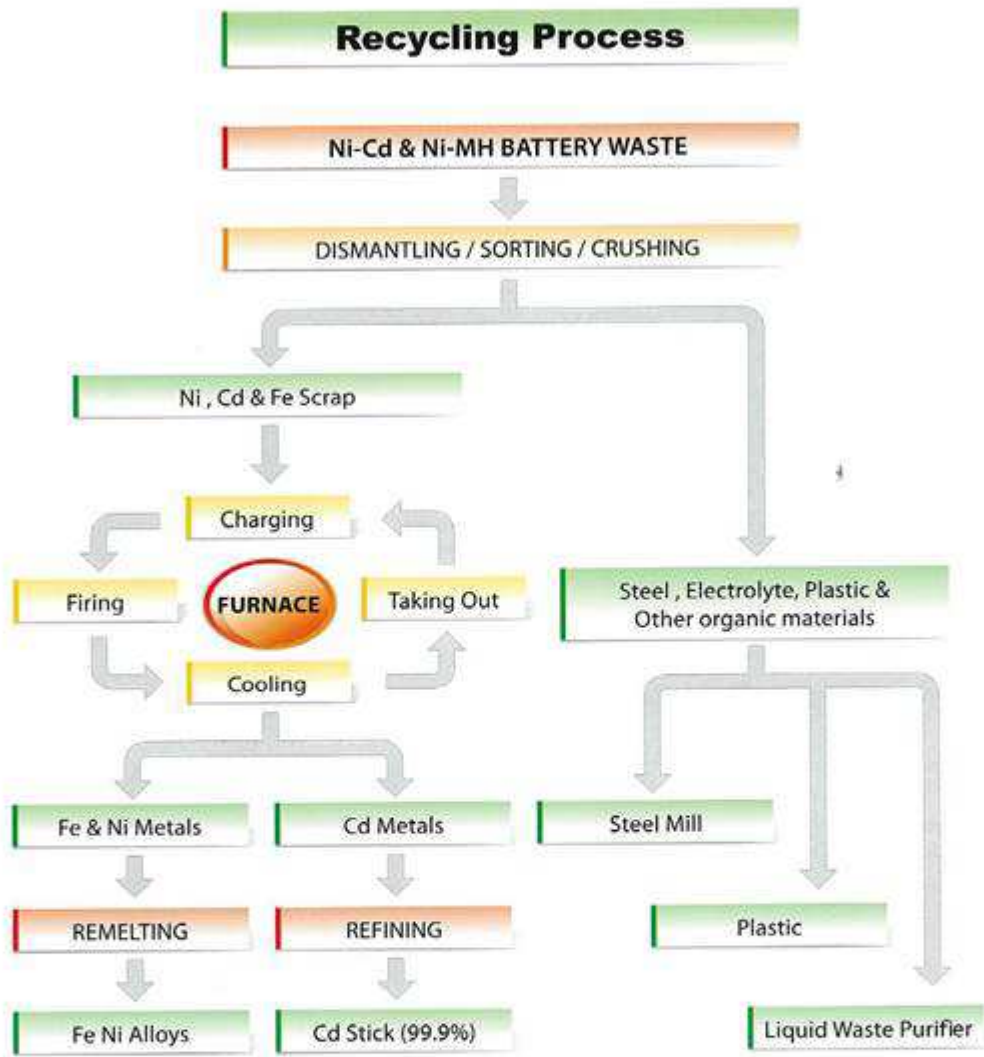
The cadmium metals in the rechargeable batteries are recycled eventually in 99.9% Cd sticks for the usage of battery application again.

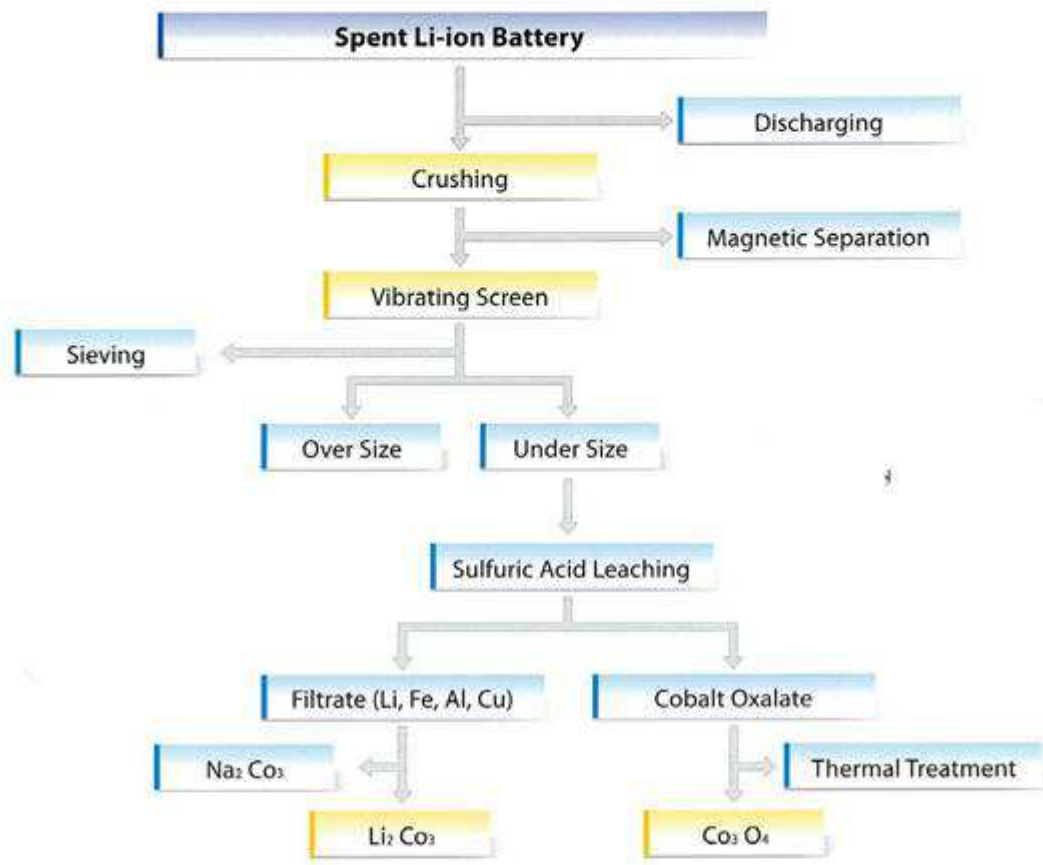
The plastic parts in the batteries are sent to the authorized plastic recycler for the recycling properly.

The electrolytes are neutralized and recycled again completely after removal of all contained heavy metals.



Cd Stick





Environmentally sound recycling system for the earth and for the clean environment



KOBAR Limited is a sole representative battery waste recycler in Asia except Japan.

The modernized recycling technology we are using today is allowed the recovery of All Hazardous Metals and Organics from all battery wastes as well as other cadmium containing wastes without any environmental pollution.

KOBAR has been authorized & approved by Korean Ministry of Environment(MOE) as an environmentally sound green-recycler and has been permitted to import Ni-Cd , Ni-MH, Li-ion & other Primary Battery Wastes from overseas countries for the recycling.

In fact, KOBAR has received various kinds of battery wastes from many countries and have recycled them without any environmental pollution at all with an intimate link with our clients in the recycling chain for clean Ni-Cd, NiMH, Li-ion and Primary Battery Recycling System.

The recycling is the most significant key concern in the world in order to keep the clean planet we have to live TOMORROW as well as TODAY.

KOBAR will endeavor to find more innovative and advanced recycling technology through research and development.

We are very proud of the leading position in the Battery Recycling Field in the world today but we continue to provide our customers with the best service and satisfaction to fulfill the customer's requirement.



Kobar(Korea Battery Recycle) Limited

- Size of company : +/- 3,300m²
- The date of incorporation : Jan 2001
- Location : Chilseo Industrial complex
Haman-Kun, Kyungnam Korea
(About 30Km North-West from Busan)
- Business Activity : Ni-Cd Battery Recycling
Ni-MH Battery Recycling
Li-ion Battery Recycling
and All Other Primary Battery Recycling
- Recycling Capacity :2,100 ton per year

The Most Modernized Clean Recycler
in Asia for All Rechargeable & Primary
Battery Wastes & Scraps



Status of KOBAR

- All Rechargeable battery Recycling
(Ni-Cd, Ni-MH and Li-ion Batteries)
- All Primary Battery Recycling
(Zn-Alkaline and Zn-C Battery)
- The Most Clean Recycling Process
(Commendation from Korean MOE)
- Very Competitive Recycling Cost
compared to Other Western Recyclers
- The only Authorized Battery Green Recycler in Asia
(except in Japan)





KOBAR Limited

KOREA BATTERY RECYCLE Limited

#296-2 Chilseo-Myun, Haman-Kun, Kyungnam-Do, Korea

<http://www.kobar.co.kr> / E-mail : kobar@kobar.co.kr

Tel : 82-55-232-3500 / Fax : 82-55-231-6300

Worldwide Supplying Agency

UMICORE Marketing Service Korea

Tel : 82-2-522-2212 / Mobile : 82-11-253-4129

Mr. KB Kim / Senior Managing Director

E-mail : kb.kim@umicore.com