[Introduction] Korea Electronic Recycling Cooperative & Current Status for FPD recycling in Korea

2 Nov 2016

Korea Electronics Recycling Cooperative

Research and Development Team

OUTLINE

- Introduction (KERC) / Legal system for E-waste in Korea
- Recycling process for end-of-life FPD in Korea

1. Amount of end-of-life FPDs collected in Korea
2. Recycling process for end-of-life FPD
3. Critical issues & discussion for recycling of the FPD

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2rd Nov 2016
Hotel PEYTO (Seoul)
Symposium on eco-friendly recycling technologies of end-of-life Flat Panel Display (FPD)

Introduction(KERC) : History & Main business

Past (2000~2014)

Association of Electronics Environment

History

- 2000. 09 Established KAEE [2003 : EPR system execution]
- 2003. 06 ~ 2011. 06 Constructed RC each of area [MRC, HRC, JRC, YRC, KRC]
- 2011. 04 Established E-waste recycling Laboratory
- 2012 ~ Executed DTD (Door to Door) service on a national scale
- 2014. 12 Re-structuring to KERC

Present (Since 2015~)

Electronics Recycling Cooperative

History

- 2014. 12 Established KERC

Business

- Mutual aid businesses to collect and recycle E-waste
- Managed laws, system related to E-waste recycling
- Research & Develop the recycling technologies
- Providing public service & Marketing for Door to Door Service

Introduction(KERC) : Basic information

Strategic Management Team

Organization & Personnel Management

Accounting Business

Mutual Aid Business Team

Manufactures, Importers, Sellers :
270 Companies(members)

Member Management

Recycling Centers, Recyclers :
40 Companies(members)

Public Service Team

Operating e-waste "Door to Door Service"

Research and Development Team

Researching technical difficulties in field

Held a Technical seminar for information sharing

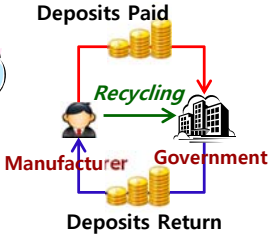
Development & maintenance of RC

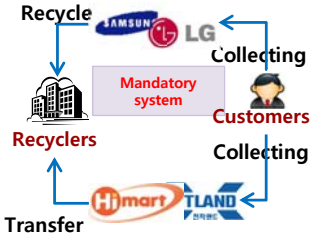
KERC

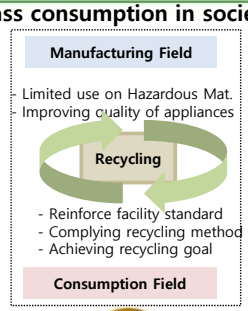
Introduction : Legal system for e-waste in Korea

Since 2014, "Target Management System [4.8kg/yr.cap, in present]

Increase in amount of waste due to mass production and mass consumption in society







1991	1993	2003	2008	2014
Separate collection of garbage	Deposit refund system	EPR System	Eco-assuarance System	Target-Management system
Cleaning managed by local gov. office	Designation of recycling business operator	Expansion Obligations to producers(Sellers)	Based on EPR, Strong regulations appearance	Expand list of Items [10 → 27 items]

KERC

Introduction : Target Management System

Summary of Target Management System in Electronics Recycling

Related Laws

- **'Act on the promotion of saving and recycling of resources'**
  (1992.12, 자원절약과 재활용 촉진에 관한 법률)
- **'Act on resource circulation of electrical and electronic equipment and vehicles'**
  (2008.3, 전기전자제품 및 자동차의 자원순환에 관한 법률

Items

- [~2014] Refrigerator, Washing machine, Air-conditioner, TV, PC, Audio, Mobile phone, Printer, Copying machine, Facsimile

[2015~] Added 17 items → Total 27 Items (electrical & electronics equipment)

Role and duty of different parties

- Ministry of Environment should announce "yearly Target amount"
- 2015 : 4.5kg/cap·yr → 2016 : 4.8kg/cap·yr

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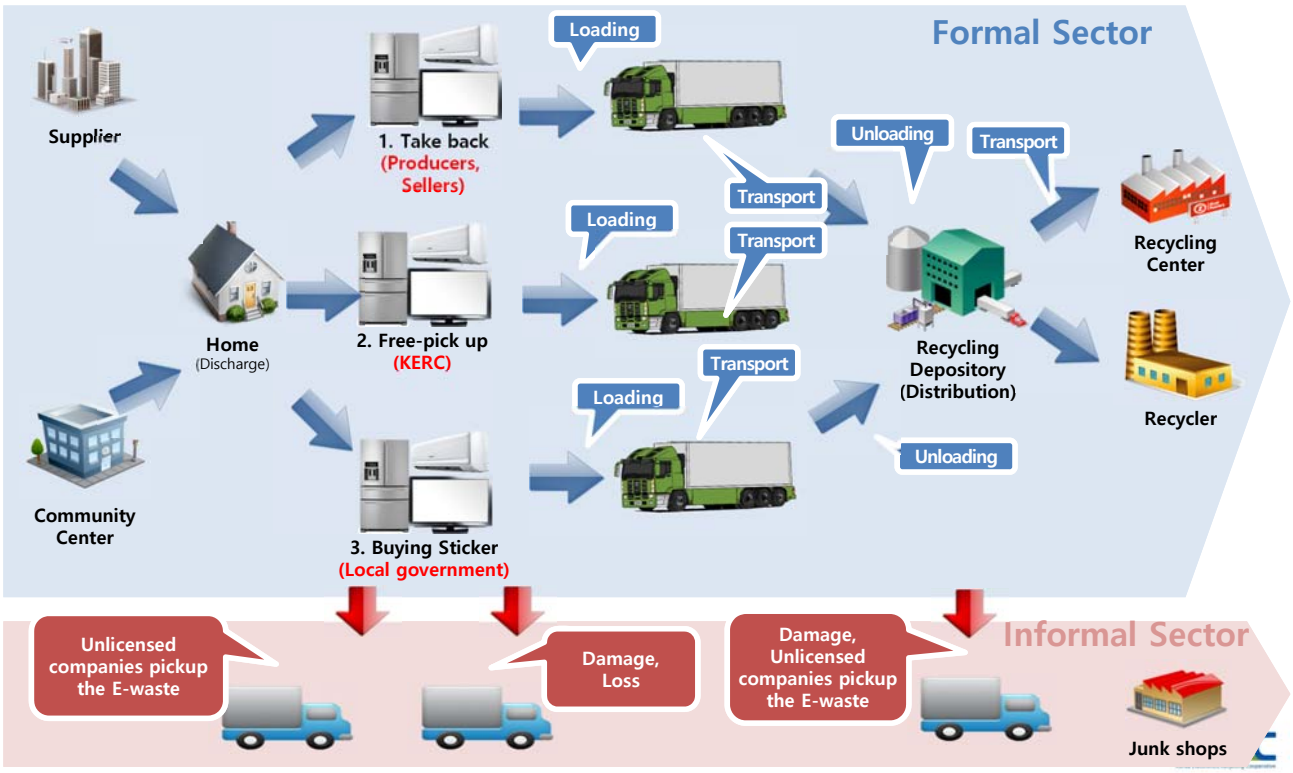
Recycling process for end-of-life FPD in Korea



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Recycling process for end-of-life FPD in Korea

Route 1

1. Take back
(Producers, Sellers)

In case of large-size H.A, take-back system occupy most of collection and transport

Approximately **70%** of whole amount in formal sector

Collection
Install

Retailers

Warehouse

Route 2

2. Door to Door service
[Free-pick up]
(KERC)

From 12 to '14, collection and transport results showed the growth rate of 940%

Approximately **20%** of whole amount in formal sector

Collection

Consignment basis

Public depository

Formal Sector

Recycling center

Route 3

3. Buying Sticker
(Local government)

Sticker price of stickers are different depending on local governments, respectively.

Approximately **10%** of whole amount in formal sector

Collection

Local Authority

Local depository

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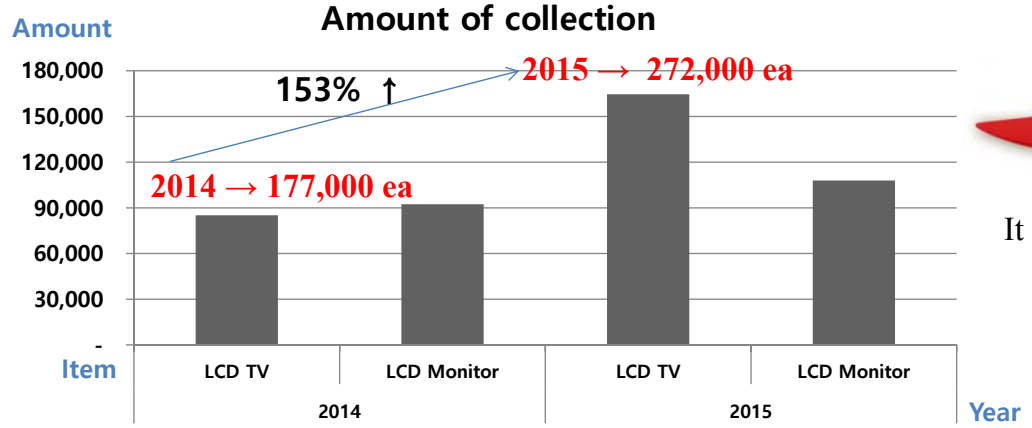
Amount of end-of-life FPDs collected in Korea

Collected & recycled amount of FPDs in Recycling Center ('14-'15)



In 2016,
It will increase..

√ **Amount that collected and recycled FPDs to R/C has reached at 272,000 in 2015**

√ **This data was not include a hidden flow thus, there are large quantities in actual fact.**

√ **The amount of end-of-life FPD is expected to increase continuously in future**

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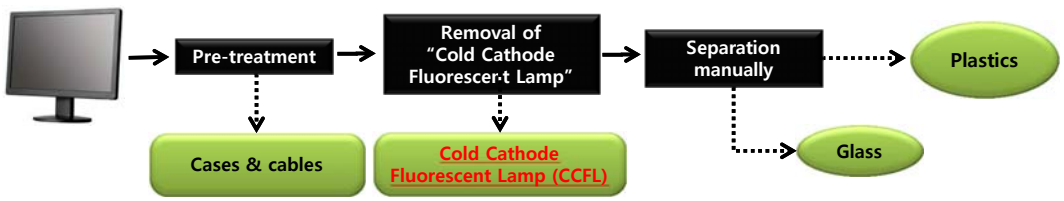
2. Schematic recycling process for end-of-life FPD

[Manual dismantling] conventional recycling processes of FPDs



Back side case | PCBs | Inner frame | Polarizing film | Inner frame | CCFL [LCD] | Glass, Plastic

Manual dismantling FPDs

Recycling capacity and work conditions in Region R/C

	Process type	Number of workers	Takt time	Capacity
MERC	Manual dismantling	2 cap	AV. 20min/ea	AV. 45ea/day
MWRC		4 cap	AV. 20min/ea	AV. 96ea/day
KRC		4 cap	AV. 12min/ea	AV. 160ea/day
YRC		3 cap	AV. 15min/ea	AV. 96ea/day
HRC		2 cap	AV. 12min/ea	AV. 80ea/day
JRC		1 cap	AV. 20min/ea	AV. 24ea/day
※ Specific tack time and capacity may differ from each RCs due to condition of work space				

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Critical issues & discussion for recycling of the FPDs

Need; Mercury recovery system [For LCD TV/Monitor]

- CCFL would have significant impact to human and environment if improperly disposed during the recycling process
- Mercury is less than 3mg per lamp from industrial references.
- Amount of mercury satisfies the domestic law match criteria but, harmlessness technology is continuously needed.

	Size (inch)	Length (mm)	Diameter (mm)	Weight (kg)	Number of lamp	Mercury (mg)	Criteria on related-law (mg)
LCD Monitor	15	320	2.0	0.004	2	5.0~7.0	7.0 (satisfied)
	17	350	2.0	0.006	4	10.0~14.0	14.0 (satisfied)
	19	390	2.5	0.006	4	10.0~14.0	14.0 (satisfied)
LCD TV	20	430	2.5	0.009	6	10.0~21.0	21.0 (satisfied)
	26	630	3.0	0.072	13	32.5~45.5	65.0 (satisfied)
	32-37	805	4.0	0.115	16	40.0~56.0	80.0 (satisfied)
	42	920	3.0	0.170	18	45.0~63.0	90.0 (satisfied)

Thank you

『폐FPD(Flat Panel Display) 친환경 재활용 처리 기술 심포지엄』

폐디스플레이 재활용기술 및 상용시스템 개발

2016. 11. 2.

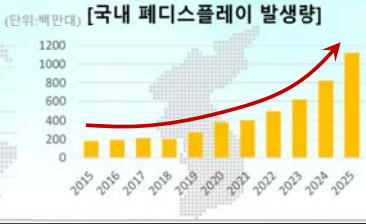
고등기술연구원

이 찬 기

발표목차

폐디스플레이 재활용 현황

국·내외 폐디스플레이 실태



국제적 환경규제 심화

[주요 국가별 환경규제현황]

● **유럽연합**
: 폐전자제품처리지침(WEEE)
: 유해물질사용제한지침(RoHS)

● **중국**
: China WEEE
: China RoHS

● **일본**
: 가전 리싸이클링법
: J-MOSS

● **미국**
: 폐전자제품 관리법
: 폐전기·전자제품재활용법

- **폐디스플레이 발생량** → 국·내외적으로 점차적 **증가** 추세
- WEEE 및 RoHS 등이 EU 회원국 별로 이미 시행 → 점차 미국, 중국 및 일본 등으로 확대 진행
- **해외 환경규제 본격화** → 정부/기업 **환경규제의 심각성 인지 및 적극적 대체 자세 요구**

국·내외 폐디스플레이 발생량 증가 및 국제적 환경규제 심화로 재활용 기술 개발이 시급한 실정

폐디스플레이 재활용 현황

LCD TV의 국내 기술 동향

- 국내 LCD제품은 **수작업에 의해 재활용** 되고 있는 실정으로 해체/분리는 재활용 센터에서 이루어지고 있으나 디스플레이의 **모델에 따른 해체가이드 부재**
  → 수작업을 통한 공정진행이 어려우며 작업 효율성이 떨어짐
- 플라스틱, 금속류 등 재활용이 가능한 부품을 제외한 **LCD 패널, BLU 등은 매립 또는 소각**.
  → 고부가가치 창출이 어렵고, 처리비용이 더 발생
- 고등기술연구원에서 폐 디스플레이 제품에서부터 해체/분리 및 소재화를 통합적으로 수행할 수 있는 1 TPD급 plant를 구축하였으며 5 TPD 규모의 pilot plant 구축을 위하여 연구를 진행 중

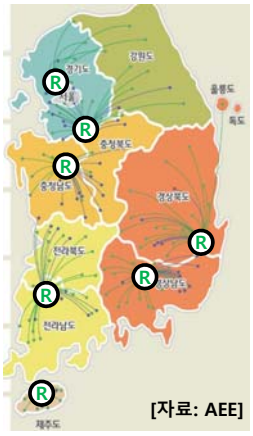
➢ Total Recycling Package – Advanced 공정+플랜트 설비+소재화

부가가치 증가!!

[고등기술연구원 1 TPD 급 폐 디스플레이 자원 재활용 통합공정 plant]

국내 폐디스플레이 처리 현황

- 전국 9개의 리사이클링 센터에서 디스플레이 수집
- 지자체, 생산자, 개인업체가 분산되어 있음
- EPR 도입 후 수거율 증가→ 아직은 저조(약 43%)
- CRT 중심의 디스플레이 해체/분리 공정
  → LCD 해체/분리 공정에 적용 시키기 어려움
  → 효율적인 LCD 재활용을 위한 처리 공정 필요



[전국 리사이클링 센터 현황 및 CRT 중심의 해체/분리 공정]

연구 개요_폐디스플레이 재활용 가능 자원

고부가가치 창출 가능


Fe, Al, SUS


ABS, PP, 혼합물

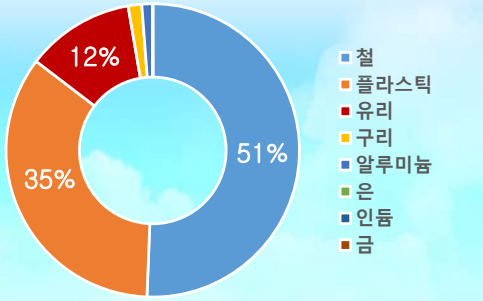

인듐


Cu, Au, Al


고무


유리

[폐디스플레이에서 회수 가능한 자원]



No.1 (51%) No.2 (35%) No.3 (12%)

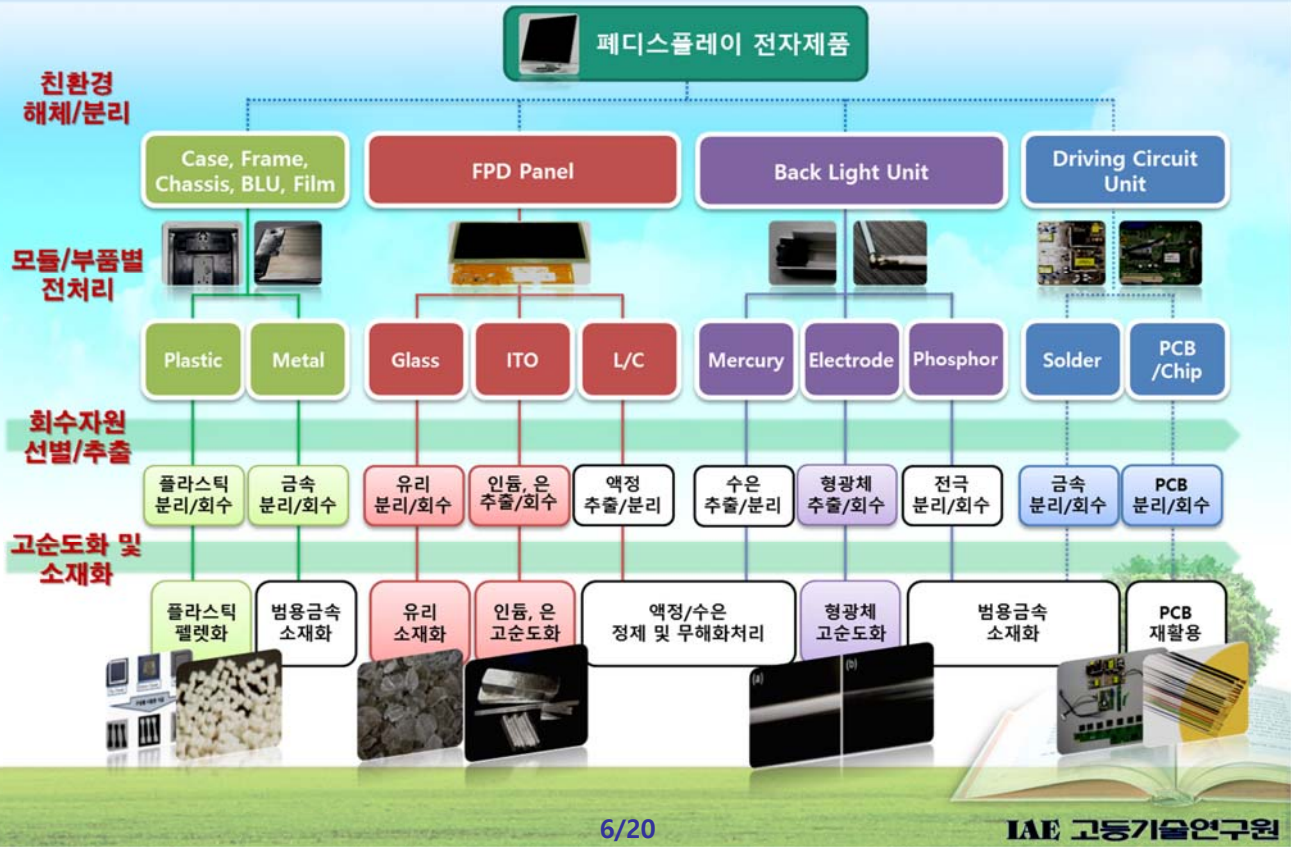
철 → 전문 업체를 통한 재자원화 실시중

플라스틱 →

유리 → X

✓ 유리의 경우 재활용 기술 부족으로 전량 매립

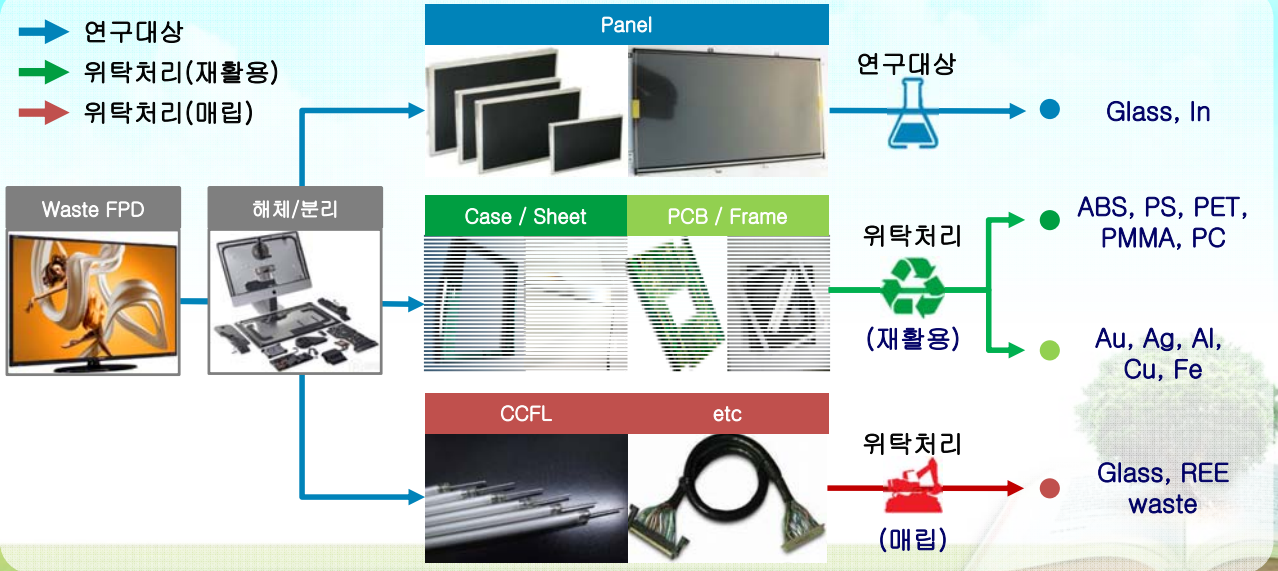
연구 개요_폐디스플레이 재활용 공정 흐름도



연구 개요_기술의 정의

- 5,000 TPY급 폐디스플레이 통합 자원화 플랜트 구축
- 해체/분리 및 패널 재활용 기술의 효율성 향상 및 신뢰성 확보

➔ 기구축된 인프라의 적절한 활용 및 선택적인 향상 방안 마련



폐디스플레이 재활용 기술 개발_비전인식 시스템

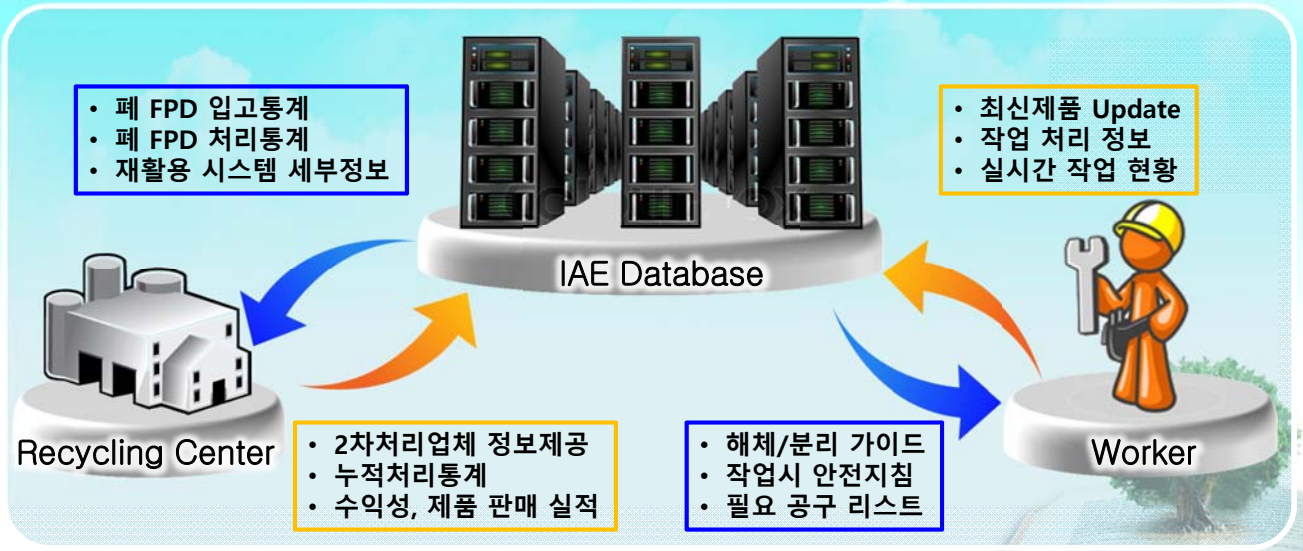
비전인식시스템 → 해체·분리 시스템 → CCFL 회수 시스템 → PCB 자원회수 시스템 → 패널 전처리 장치

- Tack time : <1min
- 처리 용량 : 11,000 lbs/day

- 입력된 DB를 바탕으로 작업자에게 **실시간으로 가이드라인 제공**
  - 해체/분리에 필요한 가이드라인 제공함으로써 작업효율 극대화
  - 예상처리량, 작업별 투입 인력 현황, 장비 점검 주기 등의 실시간 점검 가능
- 폐 FPD의 입출고 현황을 저장하고 DB화 하여 **누적 수집통계 정보 제공**
  - 월간/연간 처리량, 재활용 이익률 확보 가능
  - 재활용 부품 판매 금액 추이 파악

폐디스플레이 재활용 기술 개발_비전인식 시스템

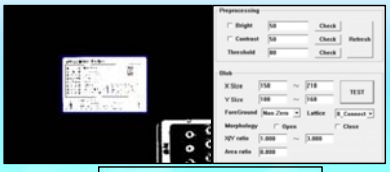
- 회수된 폐 LCD TV의 모델명, 제작 연도 등의 정보를 데이터베이스화하여 입출고 현황을 파악하고 소비자가 정보를 간편하고 쉽게 운영할 수 있도록 함.
- 각각의 공정에 필요한 정보를 제공하여 작업의 효율성을 극대화시키고 생산성을 향상시킴.



폐디스플레이 재활용 기술 개발_전용 Software

스마트 비전 인식 시스템

비전인식 운영 소프트웨어



라벨 인식 소프트웨어

모델명 인식 소프트웨어

DB관리 시스템

오토로딩 시스템

오토로딩 운영 소프트웨어

각 부품별 구동 범위 설정 소프트웨어

그래픽 UI/UX 프로그램

폐디스플레이 재활용 기술 개발_해체·분리 시스템

비전인식 시스템 → **해체·분리 시스템** → CCFL 회수 시스템 → PCB 자원회수 시스템 → 패널 전처리 장치

해체부스 1

- 작업자 동선 및 유용자원 해체/분리 순서를 고려한 저장조 위치 확보
- 작업자에게 실시간으로 가이드라인을 제공하여 해체/분리 공정 시간 단축
  - 해체부스 1 공정 소요시간 : 평균 5.5min
- 회수 유용자원 :
  - 전/후 케이스(플라스틱 3종), 받침대(고철+플라스틱), PCB(2-3종), 케이블, 비철, 스피커

폐디스플레이 재활용 기술 개발_해체·분리 시스템

비전인식 시스템 → **해체·분리 시스템** → CCFL 회수 시스템 → PCB 자원회수 시스템 → 패널 전처리 장치

해체부스 2

- 작업 효율성과 안전성을 고려한 패널 모듈 반전대 및 자동 이송장치 설계/제작
- CCFL 회수시 유출 가능한 위험물질(수은) 처리방안 고안 : 작업대, 흡입장치, 활성탄
- 작업자의 동선을 고려한 회수 컨베이어 제작
  - 해체부스 2 공정 소요시간 : 평균 6-7min
- 회수 유용자원 :
  - 시트류(도광판, 반사시트 등), 고철, 유리

폐디스플레이 재활용 기술 개발_CCFL 회수 시스템

비전인식 시스템 → 해체·분리 시스템 → **CCFL 회수시스템** → PCB 자원회수 시스템 → 패널 전처리 장치

- 처리 용량 : 88 lbs/day
- 회수 물질 : 형광체, 유리

- CCFL내 형광체 분리를 통한 **유가자원 회수 가능**
  - 기존 CCFL 처리를 위하여 매립에 지불되는 비용 절약
  - 회수된 형광체 및 유리 회수 및 판매 가능
- 폐쇄 된 작업 환경 및 공기 흡입 시스템을 통한 **안전한 작업환경 제공**
  - 폐쇄 된 잡업 환경을 통하여 외부로 수은 유출 방지
  - 공기 흡입 및 포집 시스템을 통하여 작업자 안전 확보

폐디스플레이 재활용 기술 개발_PCB 자원회수 시스템

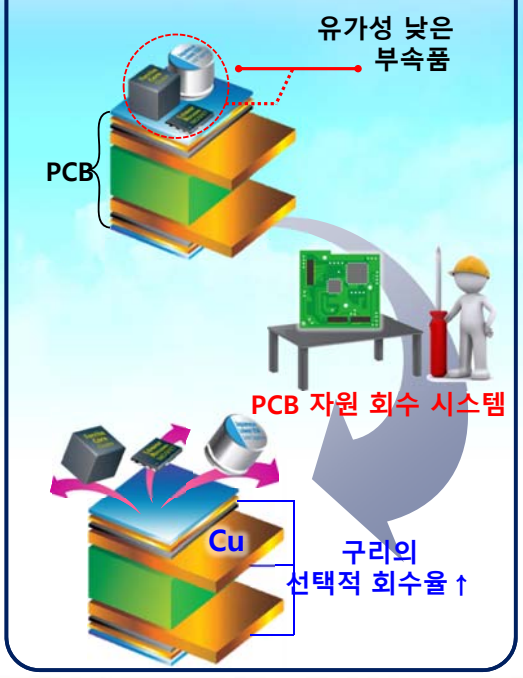
비전인식 시스템 → 해체·분리 시스템 → CCFL 회수 시스템 → **PCB 자원회수 시스템** → 패널 전처리 장치

- 처리 용량 : 550 lbs/day
- 회수 물질 : PCB 기판, 각종 소자

- 데이터베이스를 바탕으로 **실시간 Grade 별 PCB 분류**
  - 후 공정 없이 금 함유량에 따른 PCB 분류로 금과 구리 회수 효율 향상
  - 분류된 금 함유 PCB는 바로 금 회수 공정으로 투입 가능
- PCB의 소자를 분리하여 **구리 회수 효율 증대**
  - 구리가 함유 된 기판만을 분리 하여 구리 회수율 증대 및 순도 향상
  - 분리 된 소자는 추후 선별하여 다른 유가금속 회수 가능

폐디스플레이 재활용 기술 개발_PCB 자원회수 시스템

PCB 소자 분리를 통한 구리 회수 시 순도 향상



DB를 통한 금 함유량 별 PCB Grade 선별

폐디스플레이 재활용 기술 개발_패널 전처리 시스템

비전인식 시스템 → 해체·분리 시스템 → CCFL 회수 시스템 → PCB 자원회수 시스템 → **패널 전처리 장치**

- 처리 용량 : 440 lbs/day
- 회수 물질 : ITO 전극, 유리

- 패널의 편광필름 제거 및 ITO 전극 분리를 통한 유가자원 회수 가능
  - 기존 패널 처리를 위하여 매립에 지불되는 비용 절약
  - ITO 전극에서 인듐 회수 가능
  - ITO 전극과 편광필름이 모두 제거된 유리는 고품위의 유리로 사용 가능
- 데이터 베이스를 통한 실시간 조성 별 유리 분류
  - 후 공정 없이 조성에 따른 장섬유 생산 공정에 바로 투입 가능

폐디스플레이 재활용 기술 개발_10톤/일급 설계

➢ 설계 및 시뮬레이션 기준

작업 시간	일 8시간, 월 20일	공정 방식	컨베이어, 셀
준비 시간	4시간	해체시간	3분
폐 디스플레이 무게	20-25 kg	작업자	10명
평가 항목	사이클타임, 재공재고, 택트 타임, 작업자의 노동률 및 처리량		
각 공정 별 소요 시간은 실제 측정값을 기준으로 ±20%의 삼각분포를 사용			

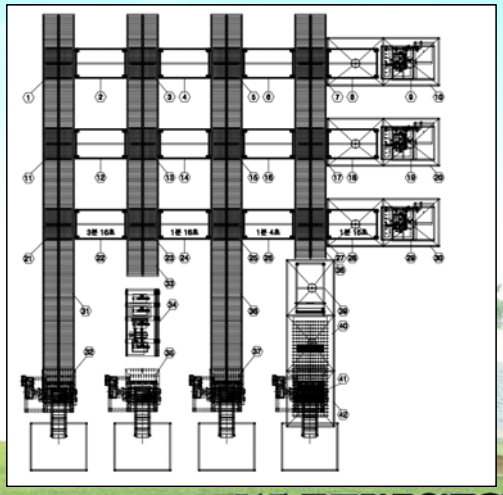
➢ 물질 수지

항목	발생량 (kg)	금액 (천원)
PCB	936	15000
플라스틱	3192	38000
케이블	120	3800
금속 (고철류)	4584	28000
비철금속	46	1800

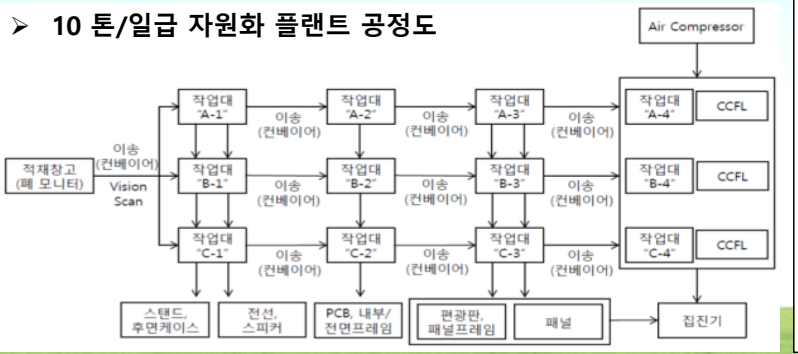
➢ 시뮬레이션 결과

구분	사이클 타임 (초)	재공재고 (대)	택트 타임 (초)	작업자 수 (명)	노동률 편차	처리량 (대/8시간)	
기본 컨베이어	364 (100%)	6.75 (100%)	107.9 (100%)	7	매우 큼	267 (100%)	6.7톤/ 8시간
컨베이어 10톤	167 (45.9%)	5.96 (88.3%)	56.3 (52.2%)	10	보통	512 (192%)	12.8톤/ 8시간
셀 10톤	123 (33.8%)	6.13 (90.8%)	60 (55.6%)	10	작음	480 (180%)	12.0톤/ 8시간

➢ 10 톤/일급 자원화 플랜트 배치도



➢ 10 톤/일급 자원화 플랜트 공정도

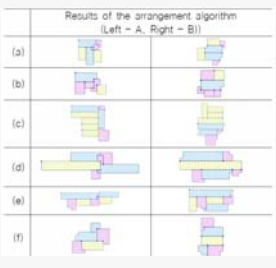


기술 발전 방안_폐디스플레이 해체/분리

실용화 플랜트 설계 및 최적화

5,000TPY급 플랜트 설계

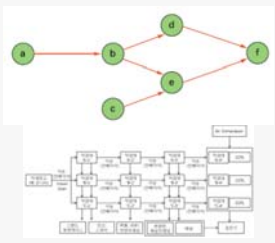
- 해체/분리 통합 플랜트 구축을 위한 라인연동 및 분배
- 멀티 생산라인 알고리즘 해석



공정 배치 알고리즘 해석

전산모사 결과 도입 및 플랜트 구축

- 멀티 프로세스 관리 시스템
- 작업라인 및 공정주기를 고려한 공정불균형률 해소



작업 효율 증대를 위한 라인밸런싱

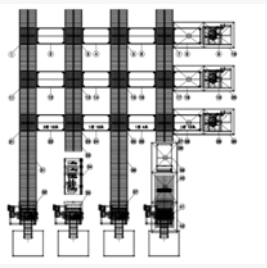
플랜트 시운전을 통한 최적화 및 신뢰성 검증

- 통합관리 시스템 분석을 통한 공정 최적화 및 신뢰성 검증
- 주변 설비를 연계한 실증운전 및 공정 성능 평가

통합관리 시스템 개발

상용플랜트 패키지 설계 (50,000TPY급)

- 수요기업 평가를 토대로 한 설계
- 환경적,경제적,기술적 가치 평가 결과 반영



상용플랜트 설계도

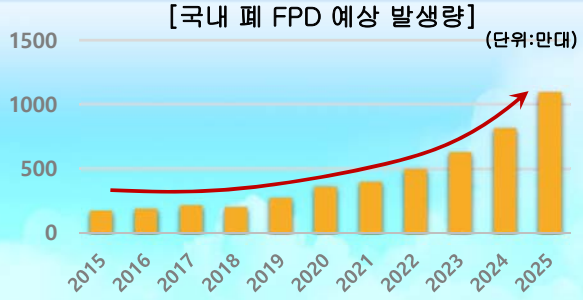
5,000 TPY급 폐디스플레이 해체/분리 플랜트 제작

사업화 방안_국내 보급

권역별 리사이클링 센터

[자료 : 한국환경공단]

[국내 폐 FPD 예상 발생량]



[국내 RC 보급 계획]

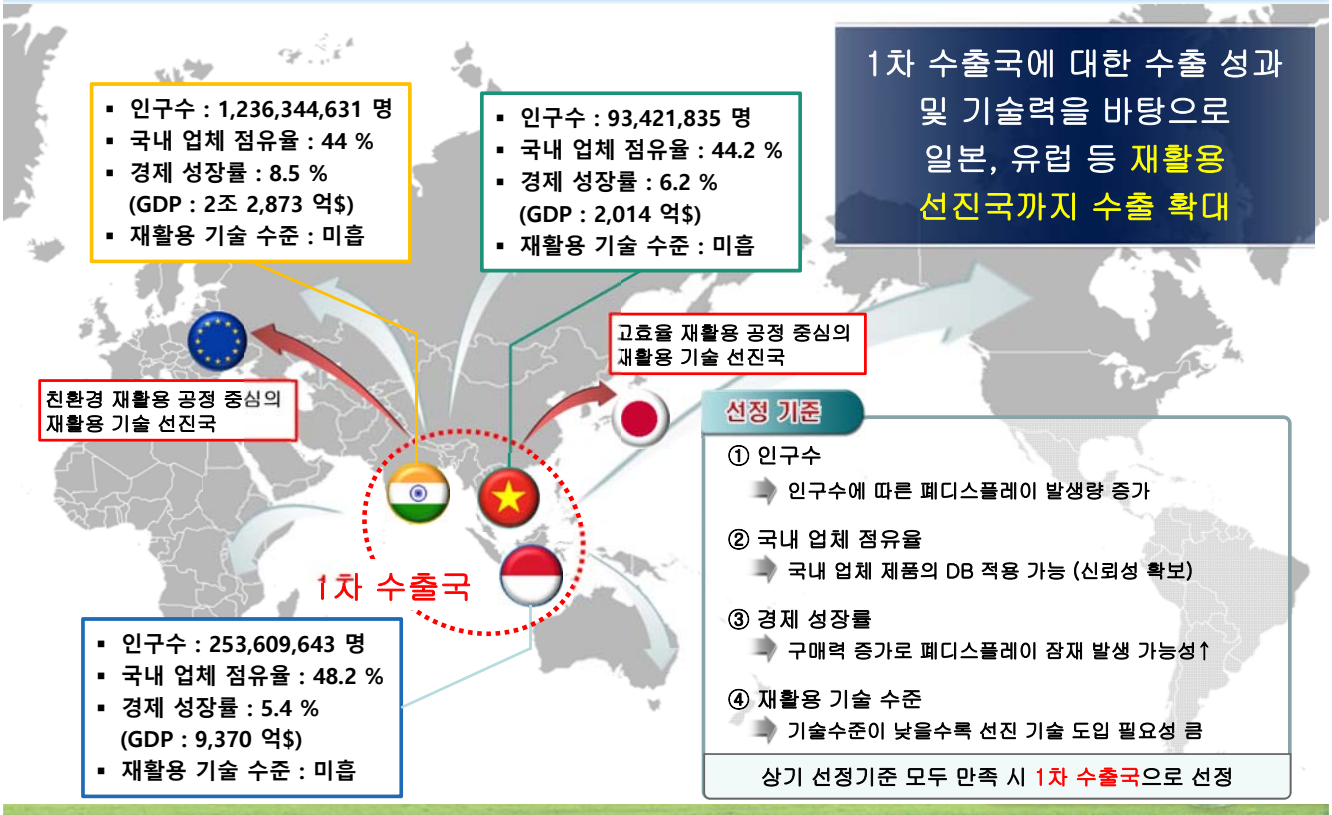
권역별	처리 비율 (%)	2018		2021		2025	
		처리량 (만)	해체/분리 라인 수(개)	처리량 (만)	해체/분리 라인 수(개)	처리량 (만)	해체/분리 라인 수(개)
수도권 +강원도	49.1	98.2	6	196.4	12	540.1	33
충청권	11.3	22.6	2	45.2	3	124.3	8
영남권	27.2	54.4	4	108.8	7	299.2	18
호남권	11.1	22.2	2	44.4	3	122.1	8
제주권	1.3	2.6	1	5.2	1	14.3	1
합계	100	200	15	400	24	1100	68

9라인 증설

44라인 증설

- 폐 FPD의 발생량이 증가함에 따라 처리해야 하는 재활용 물량 역시 증가
- 총 5개의 권역별로 수거되는 물량에 따라 전국에 분포하는 9개의 리사이클링 센터로 공급 예정
- 9개 RC의 특성을 고려한 연도별 맞춤형 사업화 계획 제시

사업화 방안_국외 보급



감 사 합 니 다.

IAE 고등기술연구원
이 찬 기
Tel. 031)330-7495
E-mail: cglee@iae.re.kr

FPD Recycling Process In KOREA

Korea Recycling Center
LEE GEONUK

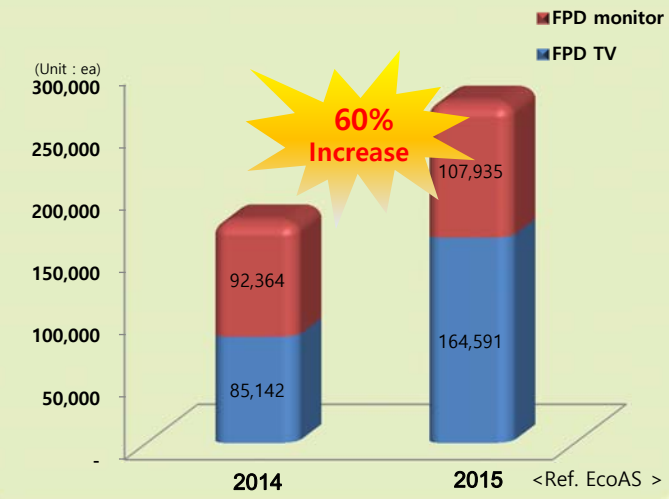
CONTENTS

Annual Recycling Volumes

Recycling Centers
which are recycling FPD

Total 24 places

Domestic Amount of FPD(24places)



<Ref. EcoAS >

KRC

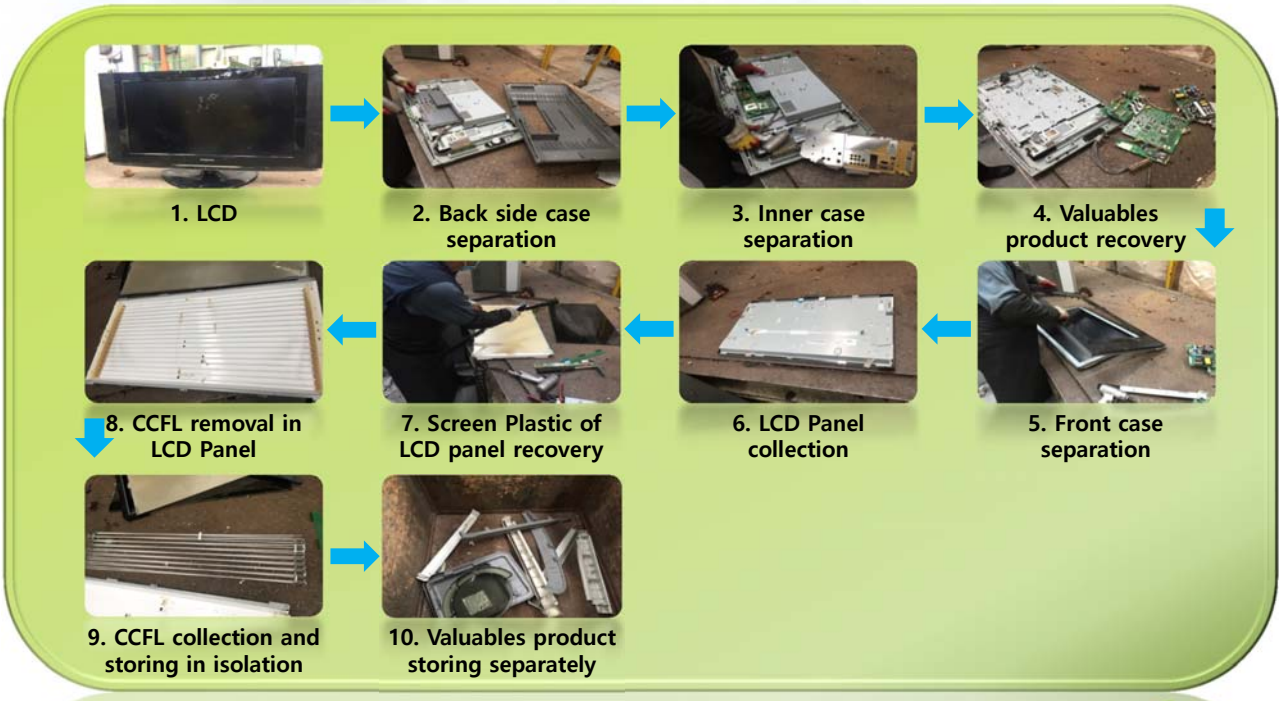
Current Process(Manual)

Mostly
"Manual" process

KRC

Current Process(Manual)

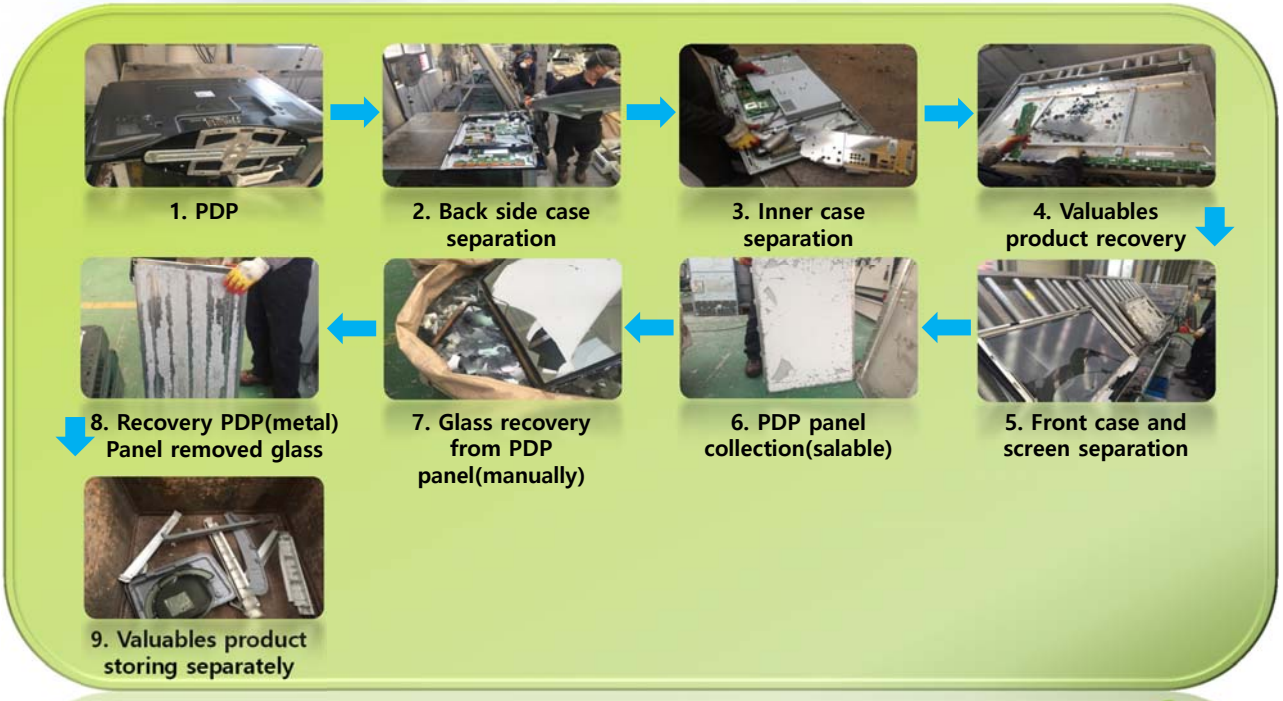
Recycling Process Flow of FPD(LCD)



KRC

Current Process(Manual)

Recycling Process Flow of FPD(PDP)



KRC

Current Process(Manual)

Problems of Manual Process

Takt Time
- Longer working hours(약 20mins/ea)
- Need more worker to recycle daily volume
- RCs operating issue due to excessive storage

Safety
- Dangers when removal glass, screw manually
- Dangerous operation followed valuable / waste product carrying operation
- Possibility of internal toxic substance exposure

Fatigue
- Accumulation of fatigue by repetitive work
- Accumulation of fatigue by lack of appropriate recycling environment for FPD recycling
- Stress occurred by lack of ensuring security

KRC

Equipment Aided Process(KRC)

Background

- ✓ Daily stock increase of LCD, PDP TV and monitors
- ✓ 2.5ea/1person/hour → 5ea/1person/hour
- ✓ Need FPD recycling line for Increasing daily volume(50%↑)

TV volume variation

Year	CRT TV(ea)	LCD.PDP(ea)
2014	72,357	9,546
2015	67,463	20,840
Variation	-6.8%	+118.3%

KRC

Equipment Aided Process(KRC)

Pre-Treatment
[Case and valuable product recovery]

Recovery glass(Ag) on PDP panel
by automatic equipment

- Before

- 2.5ea/1person/hour(24mins/1PDP)
- General Table / Manual separation(Too many screws)
- Low recycling rate(takt time)

- Change Pre-Treatment Way

- Three employees working at the same time
- Moving Table(Up & Down)
- Easy for large screen FPD
- Structure for Minimizing Fatigue

- Advantage

- Easy-Carrying / disassemble / separation
- 5.5ea/1person/hour(11mins/1PDP)
- Lower dangers and Decrease glass recovery time

KRC

Equipment Aided Process(KRC)

Video

KRC

Conclusion

Considering personnel safety

- **Considering personnel safety from the toxic substance while recycling FPD** (Minimizing exposure)
- Minimizing dangerous operation within the process / **Need for safety device**

Increasing productivity

- Need for improving productivity to treat increased storage
- Need for refinement of process efficiency regarding storage amount
- Need for refinement of process for valuable product recovery and waste removal

Minimizing fatigue and maximizing work convenience

- **Improvement equipment and process suitable for long working time**
- Improvement of productivity while considering convenience
- Minimizing fatigue occurred repetitive work (operation, equipment, etc)

KRC

KRC

Thank You

Current Japanese trend and policy on flat panel display recycling

2016 Symposium on eco-friendly recycling technologies of end-of-life Flat Panel Display

Nov 2 ,2016　at HOTEL PEYTO

Takashi Nakamura

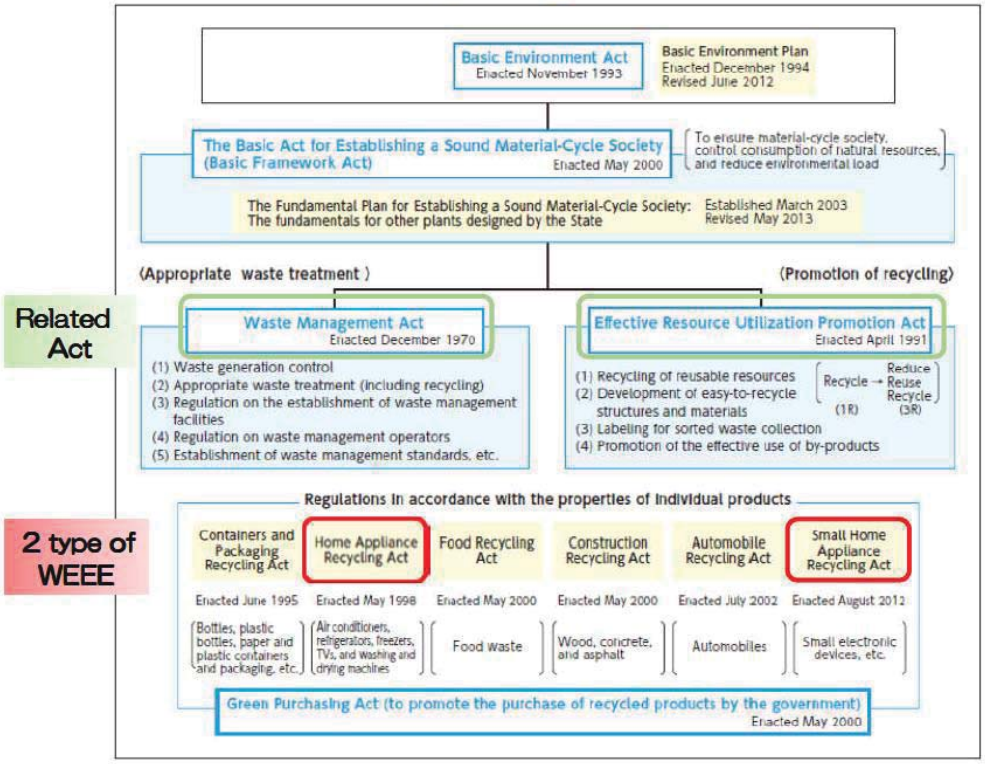
Professor, Institute of Multidisciplinary Research for Advanced Materials, Tohoku University

OUT LINE

- Introduction :

  General Recycling Policy for WEEE in Japan
- Small Domestic Electric appliance law in Japan
- Problems on Recycling of Flat Panel Display
- Future Trends on Recycling of WEEE in Japan
- Summary

Legal System

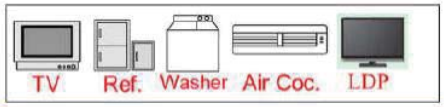


Japanese Law System for Recycling until 2013

- Fundamental Environmental Laws
  - Fundamental Law for Establishing a Sound Material-Cycle Society
    （Aim：Keep Social Material Circulation, Reduce Consumption of Natural Resources, Reduce Environmental Risks）
  - Waste Management Law
  - Law for Promotion of Effective Utilization of Resource
    - ◎ Containers and Packaging Recycling Law
      （Glass, Bottles, PET, Paper and Plastic Containers and Packaging, etc）
    - ◎ Home Appliances Recycling Law
      （Air Conditioners, Refrigerators, Washing Machines, TVs）
    - ◎ Food Recycling Law
      （Food Residuals）
    - ◎ Construction Material Recycling Law
      （Wood, Concrete, Asphalt）
    - ◎ End-of-Life Vehicles Recycling Law
      （Automobile）

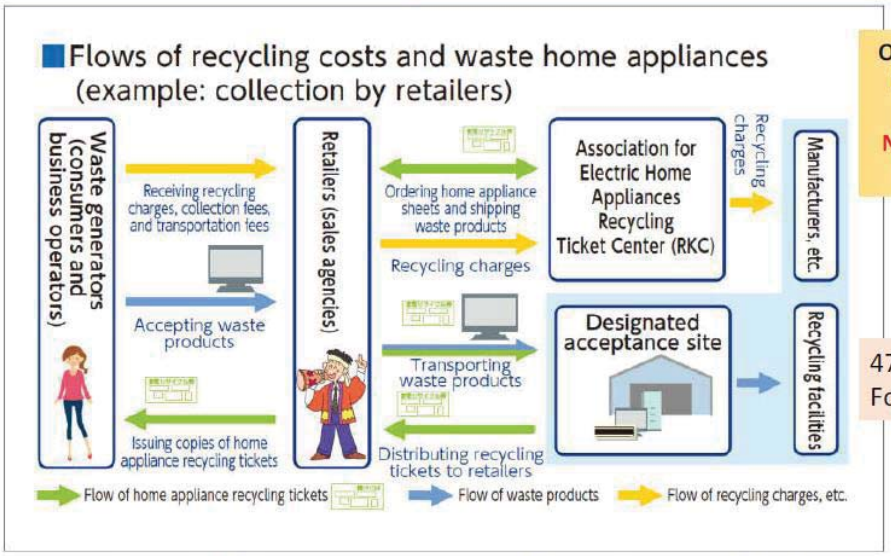
Source material by EPA and METI Japan

Home Appliance Recycling Law



Above Item, Domestic Appliance Only

Citizen's payment for recycling (when they dispose)
(including transportation & recycling) is follows (Japan) at 2010 ,
Air conditioner : about \2,625 Washer, Dryer : about \2,520
CRT, LDP, PDP : about \1,785 (under 15inch) \2,835 (over 16inch)
Refrigerator: about \3,780 (under 170 liter) \4,830 (over 171 liter)

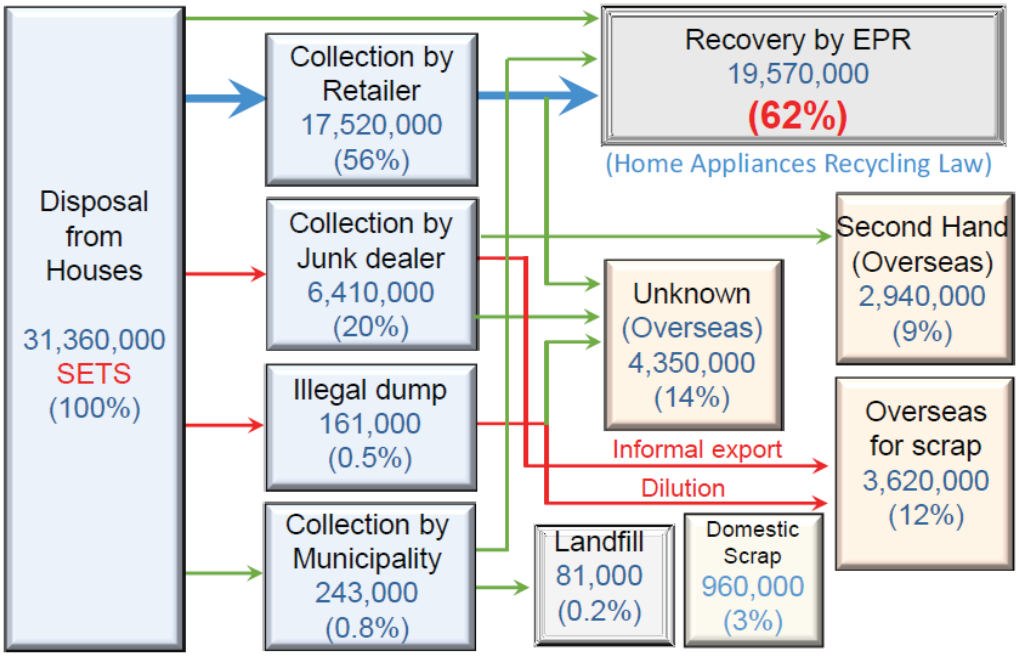


Only collected by Retailers = No Municipal collection

47 factories For Treatment

Source: Compiled from a diagram on the website of the Association for Electric Home Appliances

Flow of Large sized WEEE (2012)

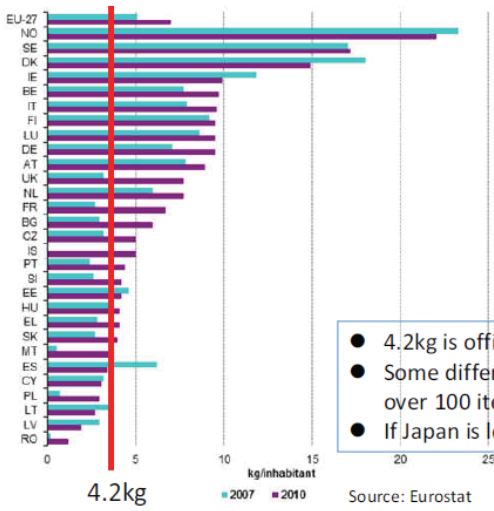


Source: Ministry of Economy, Trade and Industry (METI)

Track record WEEE collection in Japan

	Collection weight	Kg/year･inhabitant	Resources
HAR Act	511 thousand t	4.01	AEHA (2014)
SHAR Act	23,971 t	0.19	MOEJ (2014)
Total		**4.20**	

HAR: Home Appliance Recycling Act SHAR: Small Home Appliance Recycling Act
AEHA: Association for Electric Home Appliances



4.2kg

Source: Eurostat

Ranking	Country(2013)	WEEE collection
1	Norway	20.66
…		
17	Poland	4.52
18	Japan	4.20
19	Slovenia	4.15
…		
33	Romania(2012)	1.15

- 4.2kg is official and visible track record of WEEE Japan.
- Some different such as number of targetted WEEE items(EU: over 100 items, Japan 32 items), and legal system.
- If Japan is located in EU the record is not so good.

Clean and High performance

Tokyo Eco Recycle (Hitachi Group Company)

Air Conditioner

CRT

LCD

Refrigerator

Washing machine

- 47 factory of HAR are in Japan.
- All HAR factories are operated by manufacturer EPR system.
- Some HAR factories treat SHAR items.
- There is another facilities that treat SHAR items only.

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The existing actions for Japanese WEEE

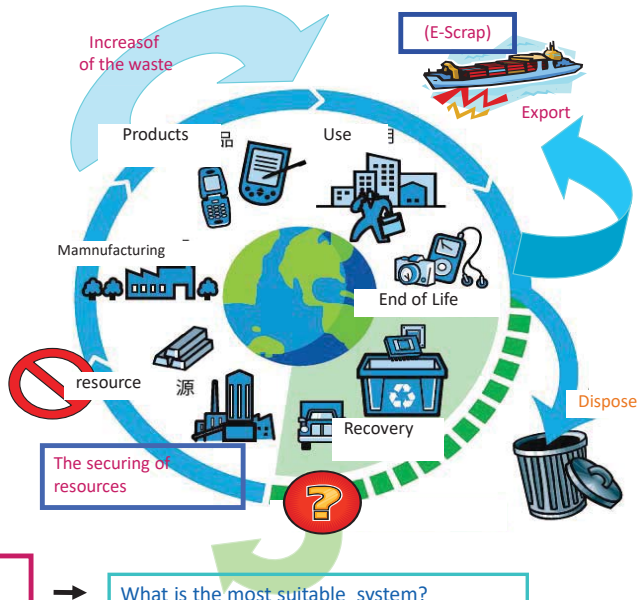
The existing actions for Japanese WEEE

(1) Law Base
- Home Appliance Recycling Law
(Air Conditioner, Refrigerator, CRT, LCD, PDP, Washing Machine, Clothing dryer)

(2) Self-action by Manufacturer
- Mobile Recycling Network (Mobile Phone)
- PC-3R (Computer)

(3) Uncontrollable Reuse and Recycle
- Reuse as a Secondhand goods
(Japan, Southeast Asia)
- Exported to Other countries (for Recycling)

(4) Disposal
- Be dispose of in landfill as the general garabage
(municipal waste)
- illegal Disposal



Because WEEE continues increasing, it is necessary to solve malfunction of system.

→ What is the most suitable system?

Law for the Promotion of recycling of small domestic electric appliances

This law was enforced from April ,2013.

Basic concept

In order to prevent the outlaw of domestic resources and the spill of hazardous materials to developing countries, new law aim to do as follows.

Local governments are encouraged to separate WEEE from the municipal waste land that disposed them currently.

Government directs the proper recycle route and certify good recycler.

Government must do the bed trader crackdown, the measures of customs inspection, more strictly.

Under this law, only certified WEEE recycler and their operating routes can receive WEEE from the local government. Local governments give the collected WEEE to the certified recyclers.

Certified recycler can operate without the permission of the particular regulation of some of the waste law. (For examples, transporting and processing of municipal solid waste is required permissions in each municipality)

Manufacturers do not undertake any obligation to recycle process.

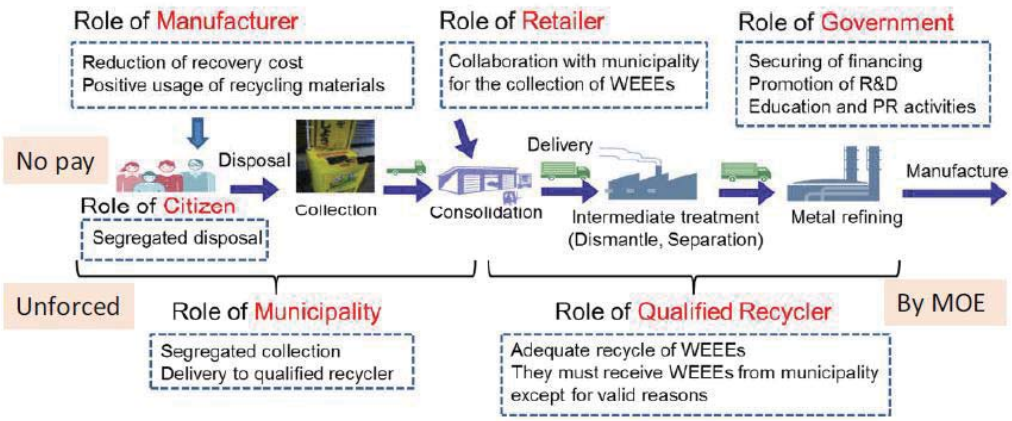
Eventually, this law does not impose obligation to anyone, just promoting the recycling SDA. So, how many municipalities will join is important point.

Small Home Appliances Recycling Law (2013-)

Domestic small sized WEEE except for the items of Home Appliances Recycling Law.
Not EPR system, Applied Municipal waste management,
Destination control of Small sixed WEEE

Landfill, improper Scrap → Proper Treatment (Hazardous Treatment , and Resource Recovery)

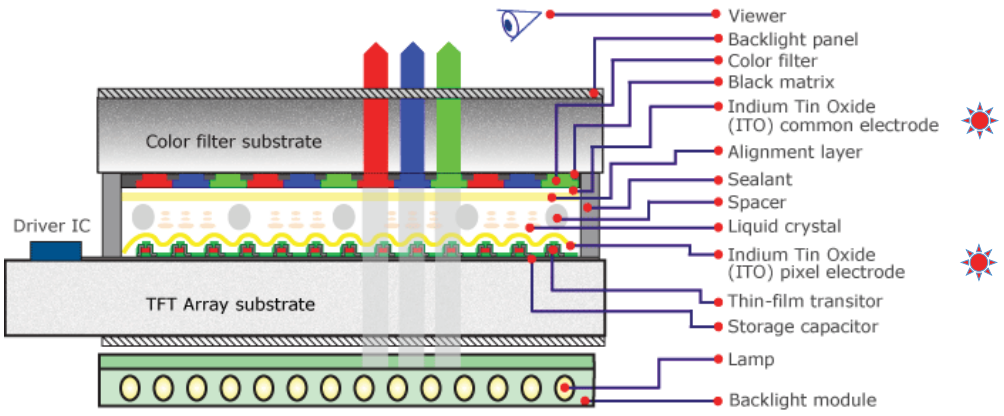
Participation of Municipalities to this system is not mandatory.



OUT LINE

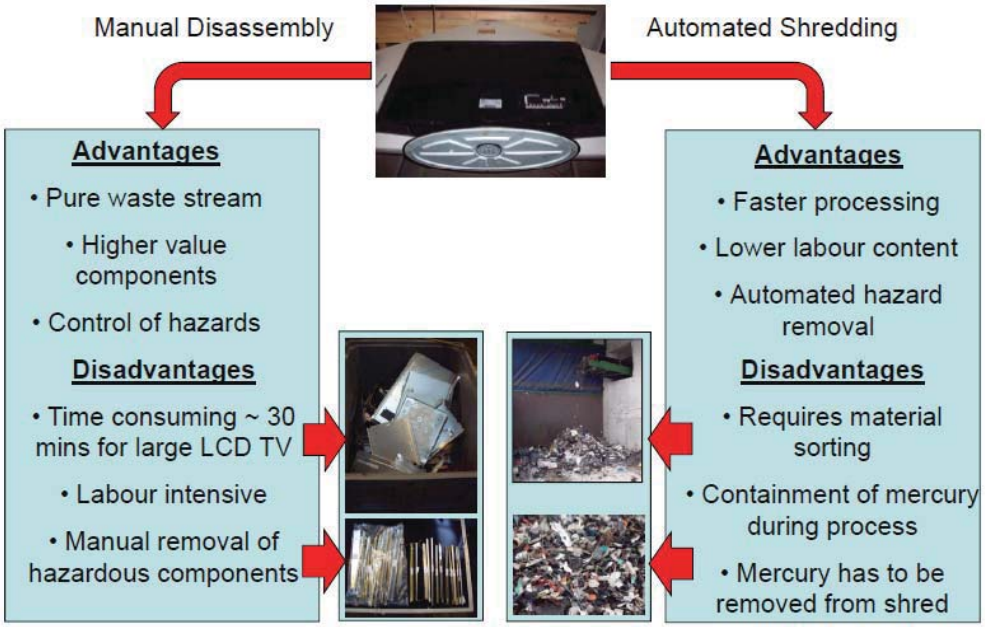
- Introduction :
  General Recycling Policy for WEEE in Japan
- Small Domestic Electric appliance law in Japan
- Problems on Recycling of Flat Panel Display
- Future Trends on Recycling of WEEE in Japan
- Summary

STRUCTURE OF LCD (CROSS-SECTION VIEW)



- a LCD contains several electro-conductive electrodes, which are made mainly of **i**ndium **t**in **o**xide (ITO).
- ITO is a mixture of indium(III) oxide (In_2O_3) and tin(IV) oxide (SnO_2), typically 80 to 90% In_2O_3 and 10 to 20% SnO_2 by weight.
- a LCD contains approximately 1,400 g/t indium (In), if all the parts made of organic material are removed in advance.
- A cellular phone contains *ca.*6.2 mg In.

Two ways of LCD recycling

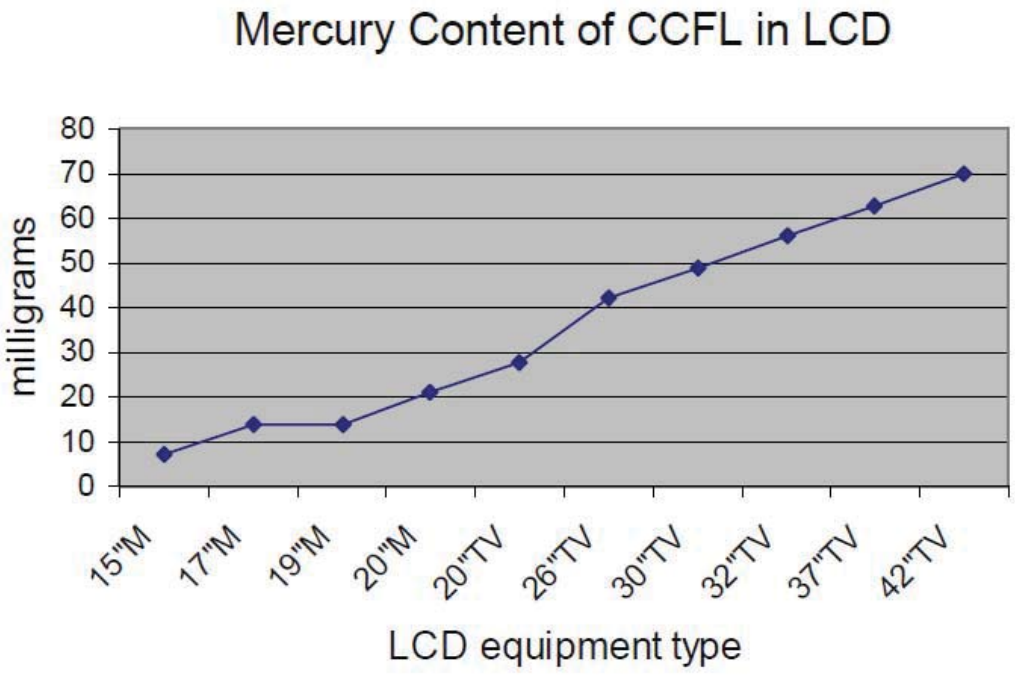


Tim J McDonnell and Karl S. Williams 5th World Recycling Forum 2010

Minamata Convention on Mercury

- In order to prevent global environmental pollution and health damage caused by mercury, a new convention named "Minamata Convention on Mercury" was agreed at the fifth session of the Intergovernmental Negotiating Committee to prepare a global legally binding instrument on mercury (INC5) held in Geneva, Switzerland in January 2013. The Convention will be adopted and open for signature at the Conference of Plenipotentiaries (Diplomatic Conference) to be held in October in Japan.

- The Conference of Plenipotentiaries on the "Minamata Convention on Mercury" was held in Minamata and Kumamoto in Japan from 9 to 11 October 2013 and was preceded by intergovernmental preparatory meeting from 7 to 8 October 2013.



Tim J McDonnell and Karl S. Williams 5th World Recycling Forum 2010

Current Approach in Recovering Indium from LCDs

❖… about 70 % of indium is extracted from ITO scrap. → main recycling route

❖… how to recover indium from ITO:

1. **Pyrometallurgical treatment** of LCDs at relatively high temperature (from 500K to 1473 K):

   Main Disadvantage:

   - the energy consumption is relatively high.
   - the extraction of indium is relatively low.

2. **Hydrometallurgical process** :

   Advantages:

   - Low energy consumption in dissolving ITO, and then recovering relatively high puroty indium.

   Main Disadvantage:

   - It requires a relatively large volume of solvent (typically HCl solution) for leaching.

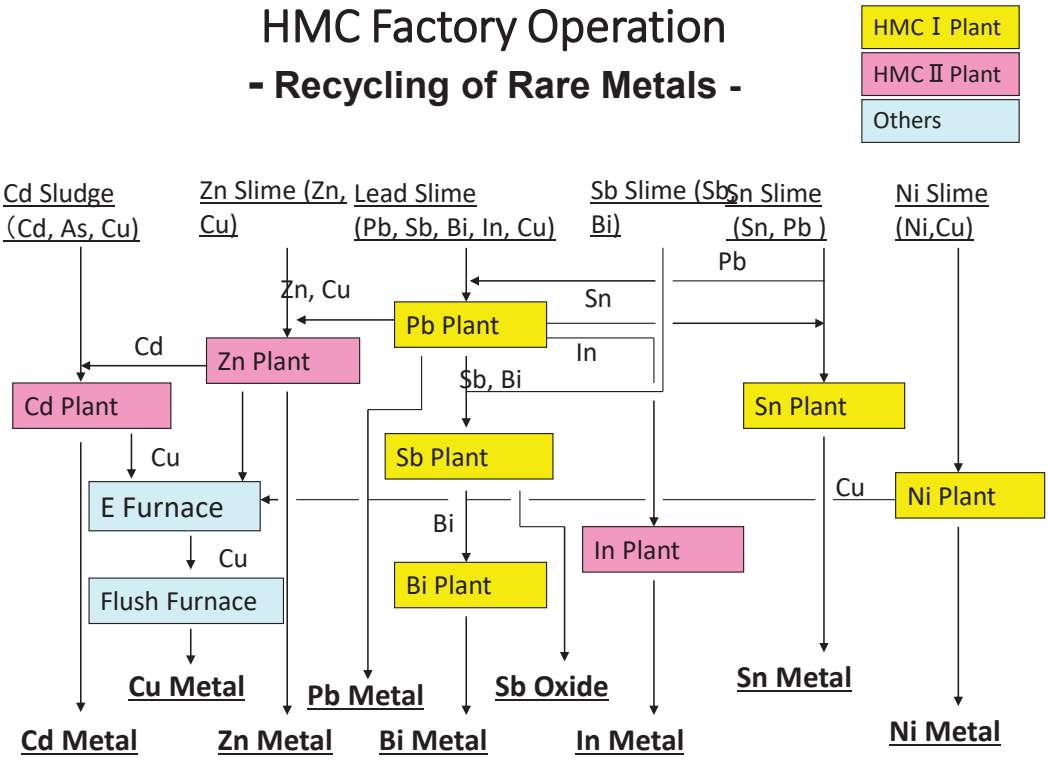
Most difficult point In Both processes is only 1g ITO can be recovered from Large LCD after waste LCD from consumer.
Key point of FPD recycling is not to recover In but how to recycle glass and how to treat Hg

An Example –Recycling Plant in HMC Factory
– Minor Rare Metals Recycling Plant –

Plant		Capacities	Operation
HMC Ⅰ	Nickel	40 (t/M)	2008/8
	Tin	40 (t/M)	
	Lead	100 (t/M)	
	Antimony	14 (t/M)	
	Bismuth	19 (t/M)	
HMC Ⅱ	Zinc	60 (t/M)	2009/2
	Indium	1 (t/M)	
	Cadmium	9 (t/M)	Not decided

From JX Nikko Metal Corporation

HMC Factory Operation
- Recycling of Rare Metals -



From JX Nikko Metal Corporation

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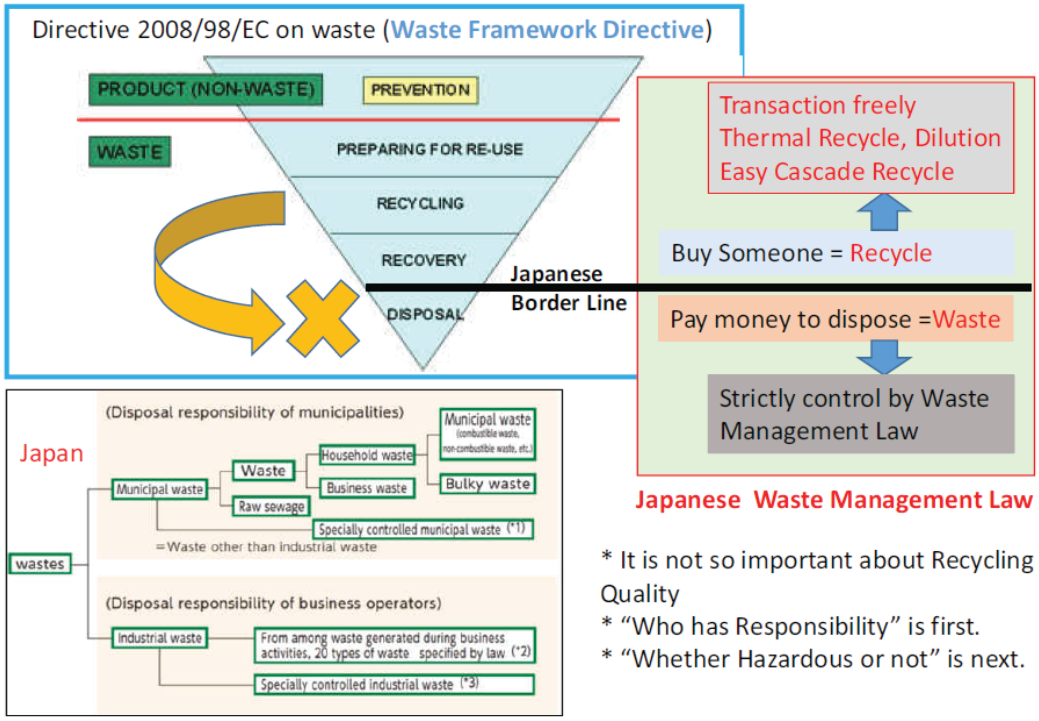
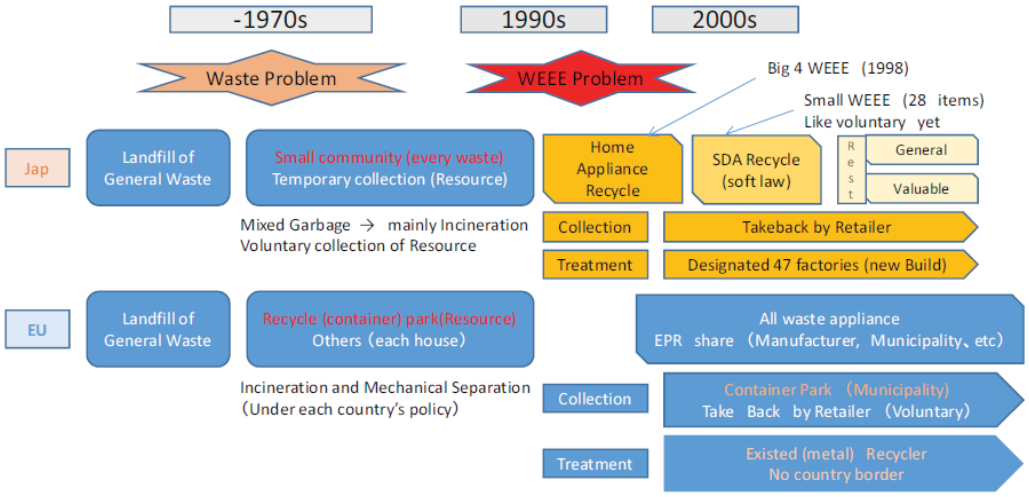
Difference of Waste Framework



* It is not so important about Recycling Quality
* "Who has Responsibility" is first.
* "Whether Hazardous or not" is next.

WEEE collection method was affected by original general waste collection



- General garbage collection method of Japan and EU is separated in 1970s. WEEE collection method was affected by this.
- Responsibility of Manufacturer in Japan is so strong than EU case. There is almost no responsibility for municipal collection.

Conclusions

The condition for material recycling in Japan is gradually improving by enforcement of Home Appliance Recycling Law.

Small and middle sized electric appliances except for Air conditioner, Refrigerator, Washing machine, TV-set, have been recycled, However, amount of them don't leach a current target that is 1kg/capita.

Certain amount of the metals in these WEEEs are disposed, and become unrecoverable form in the land fill site, now. Also, the problem of an outflow about WEEE towards a foreign country cannot be disregarded.

Key point of LCD recycling is not to recover In but how to recycle glass and how to treat Hg. LED lumps are used in very recent LCDs then no more use of Hg is one of problem after safe recovery of Hg from back lights. It is almost same problem of CRT recycle.

Further trial for new collecting system that combine municipal waste and industrial waste is necessary.

スズトクホールディングス株式会社

液晶パネル等のリサイクルの現状について

スズトクホールディングス株式会社
執行役員　新事業開発部部長　兼　遵法・安全室管掌　　今井　佳昭

電話番号：03-5204-1889
メールアドレス：yoshiaki-i@suzutoku.co.jp

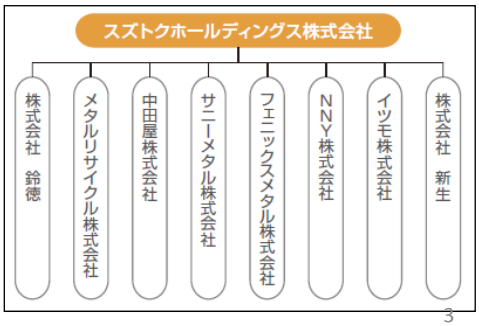
目　次

スズトクホールディングス株式会社

会社概要

会社名：　スズトクホールディングス株式会社
英文社名：SUZUTOKU Holdings Co.,Ltd.
所在地：　東京都千代田区大手町1-7-2　東京サンケイビル15階
設立：　2007年 7月 2日
社員数：　635名(2016年6月30日時点　グループ全体)
資本金：　100百万円
売上高：　385億円(グループ全体=各社単体の直近決算期合算)
事業内容：
　グループの事業(リサイクル・廃棄物処理とその関連業務)の統括
　グループの経営の統括・戦略の立案
　グループのITシステムの開発・管理
　グループのコンプライアンス・環境・ISO・安全衛生に関する業務および教育・研修
　グループの管理部門のサポート
事業会社：　8社

▼グループ会社

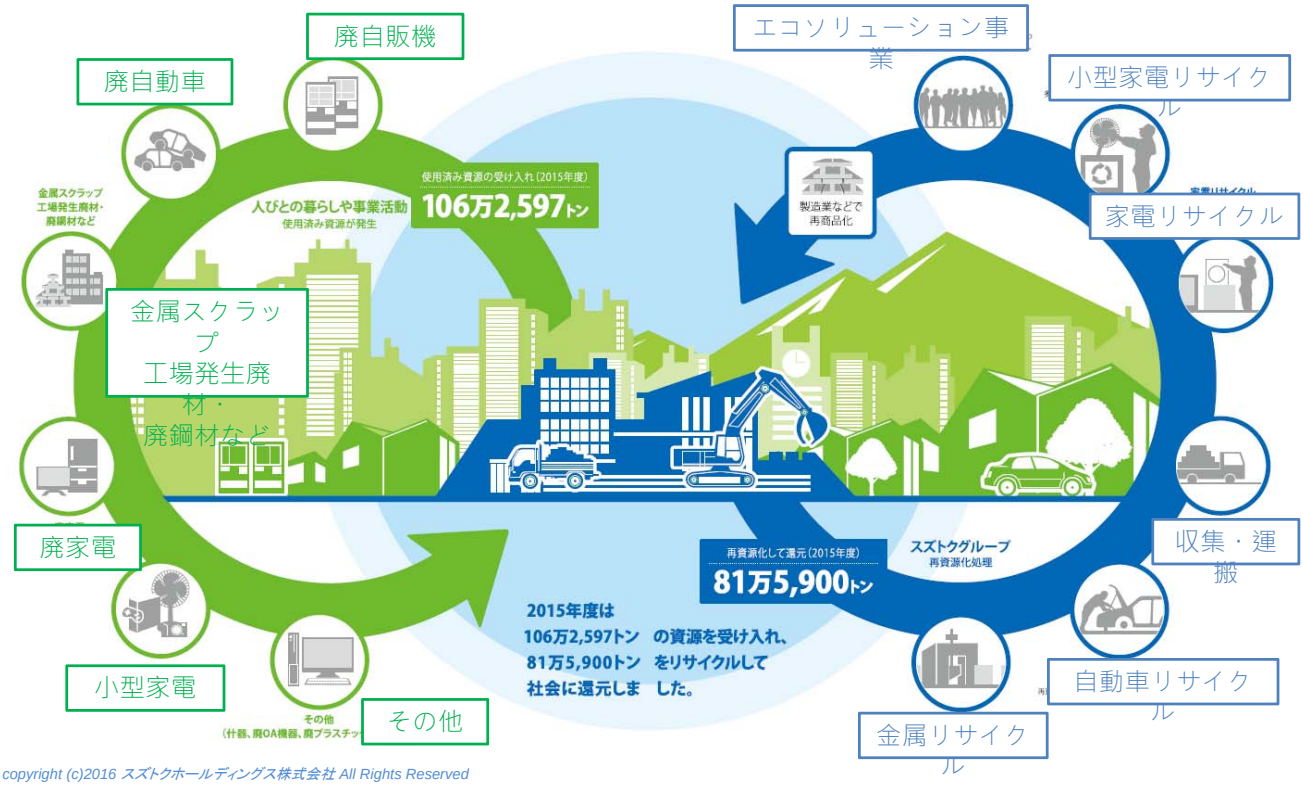


日本における循環型社会を形成するための法体系

2015年度　受入資源量と再生資源量

スズトクホールディングス株式会社

約84%を社会に還元



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スズトクホールディングス株式会社

日本における家電リサイクル法（2001年4月1日施行）

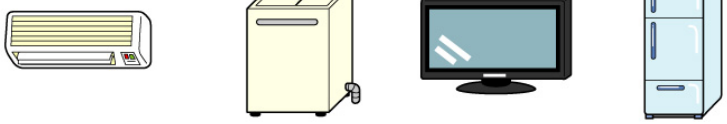
スズトクホールディングス株式会社

1. 目的
　小売業者、製造業者等による家電製品等の廃棄物の収集、再商品化等に関し、これを適正かつ円滑に実施するための措置を講じることにより、廃棄物の適正な処理及び資源の有効な利用の確保を図り、もって生活環境の保全及び国民経済の健全な発展に寄与することを目的とする。

2. 対象機器
　家電製品を中心とする家庭用機器から、・市町村等による再商品化等が困難であり、・再商品化等をする必要性が特に高く、・設計、部品等の選択が再商品化等に重要な影響があり、・配送品であることから小売業者による収集が合理的であるものを対象機器として政令で指定する。エアコン、テレビ、冷蔵庫・冷凍庫、洗濯機について、平成１０年１２月にこれら４品目を指定。

3.「再商品化等」の定義
(1)対象機器の廃棄物から部品及び材料を分離し、これを製品の原材料又は部品として利用すること
(2)対象機器の廃棄物から部品及び材料を分離し、これを燃料として利用すること。

家電リサイクル法で
定められた4品目

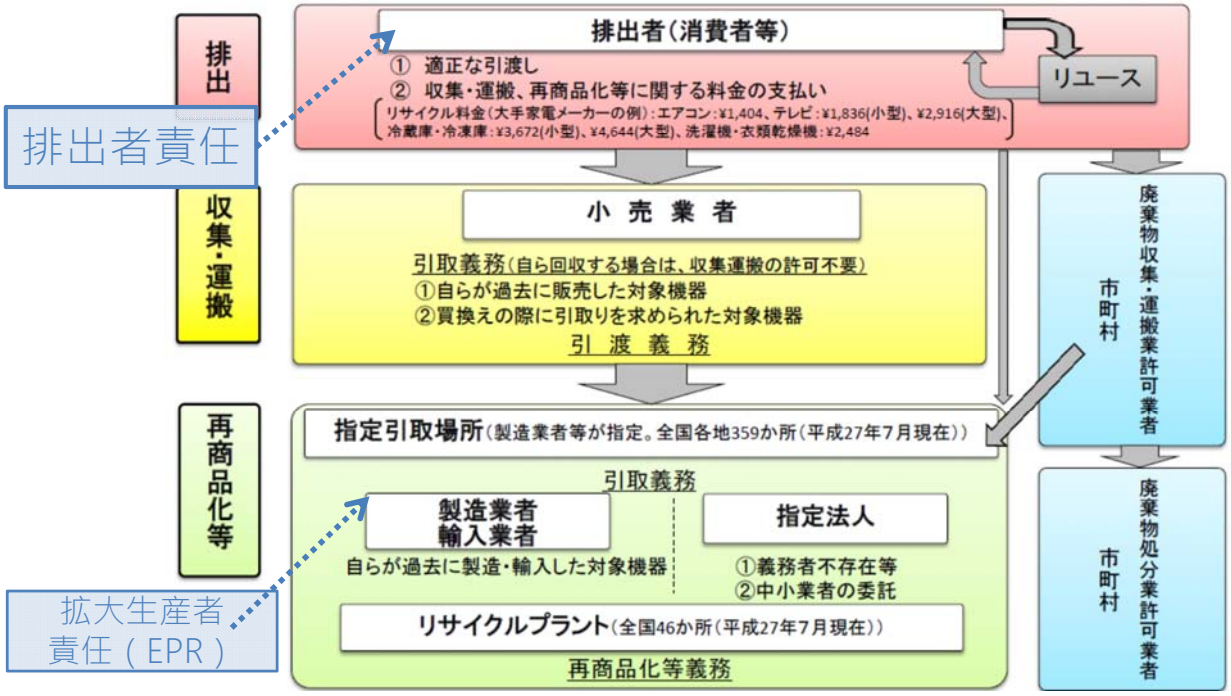


家電リサイクル法の概要

スズトクホールディングス株式会社

〔参考〕家電リサイクル法のポイント

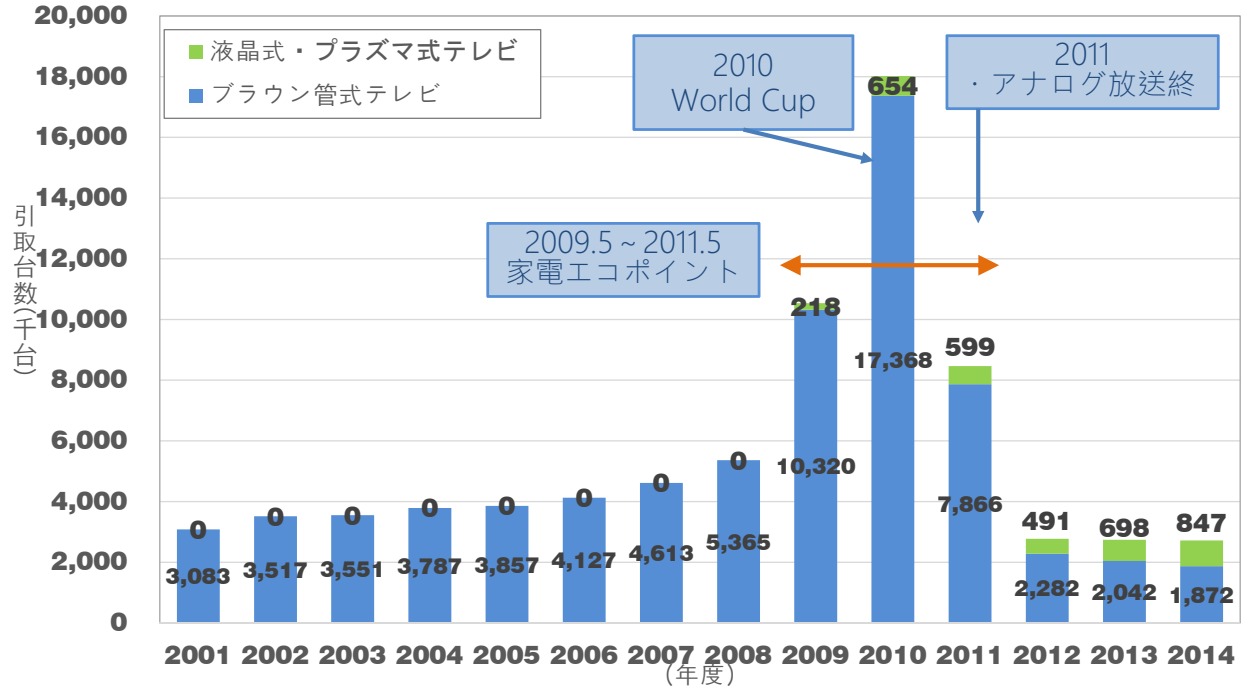
廃棄物の適正な処理及び資源の有効な利用の確保を図り、もって生活環境の保全及び国民経済の健全な発展に寄与することを目的（経済産業省・環境省の共管法）。



※環境省HPより引用　（http://www.env.go.jp/recycle/kaden/gaiyo.html　，2016.10.20）

製造業者等の引き取り台数の推移（TV）

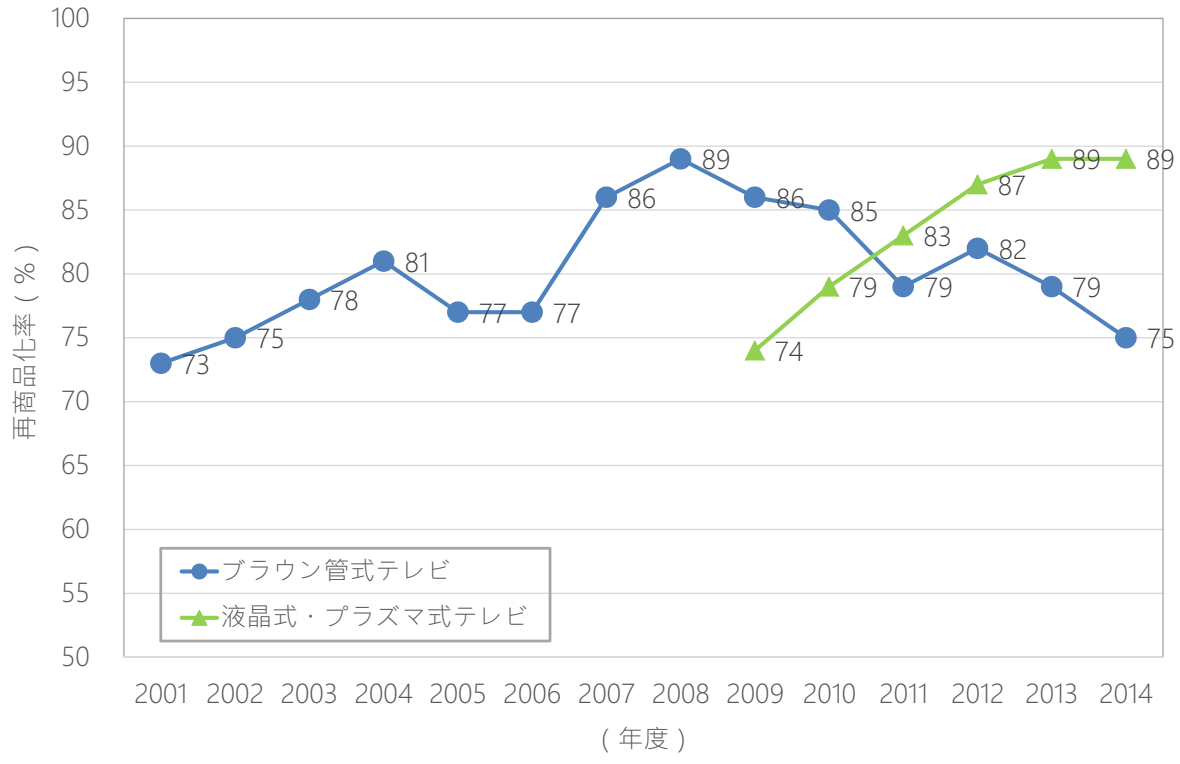
スズトクホールディングス株式会社



※　平成26年度版 家電リサイクル年次報告書（一般財団法人家電製品協会）より作成

製造業者等における再商品化率の推移（TV）

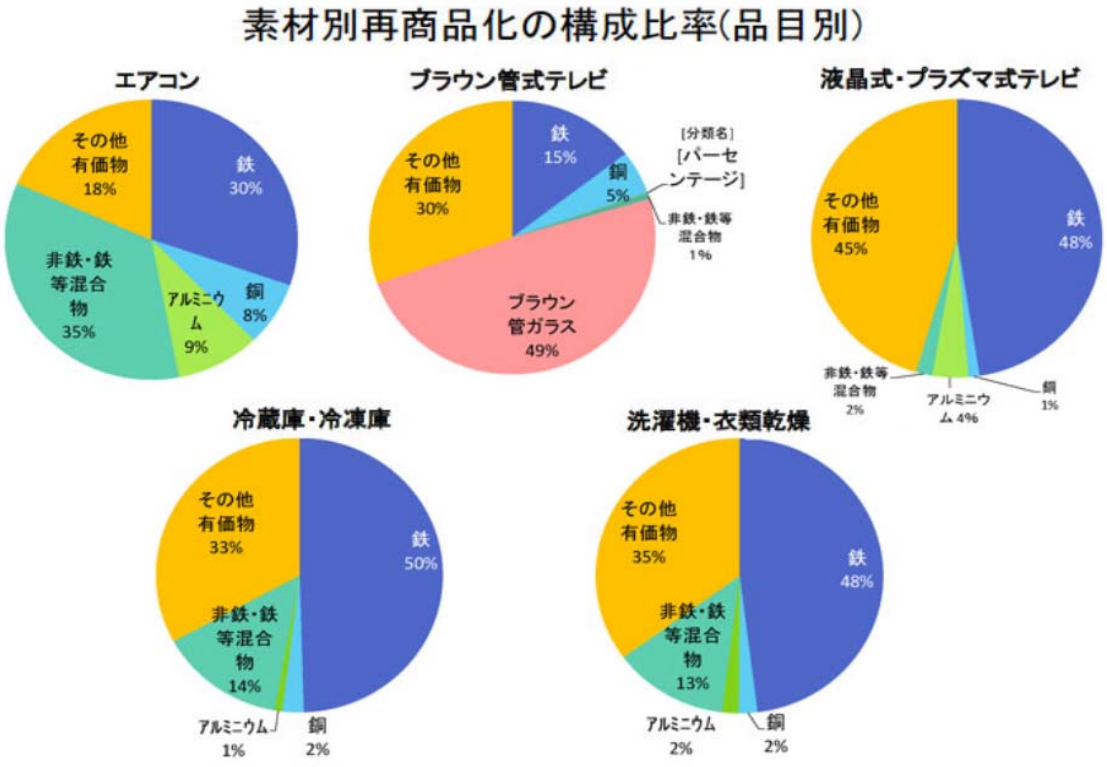
スズトクホールディングス株式会社



※　平成26年度版 家電リサイクル年次報告書（一般財団法人家電製品協会）より作成

素材別再商品化の構成比率

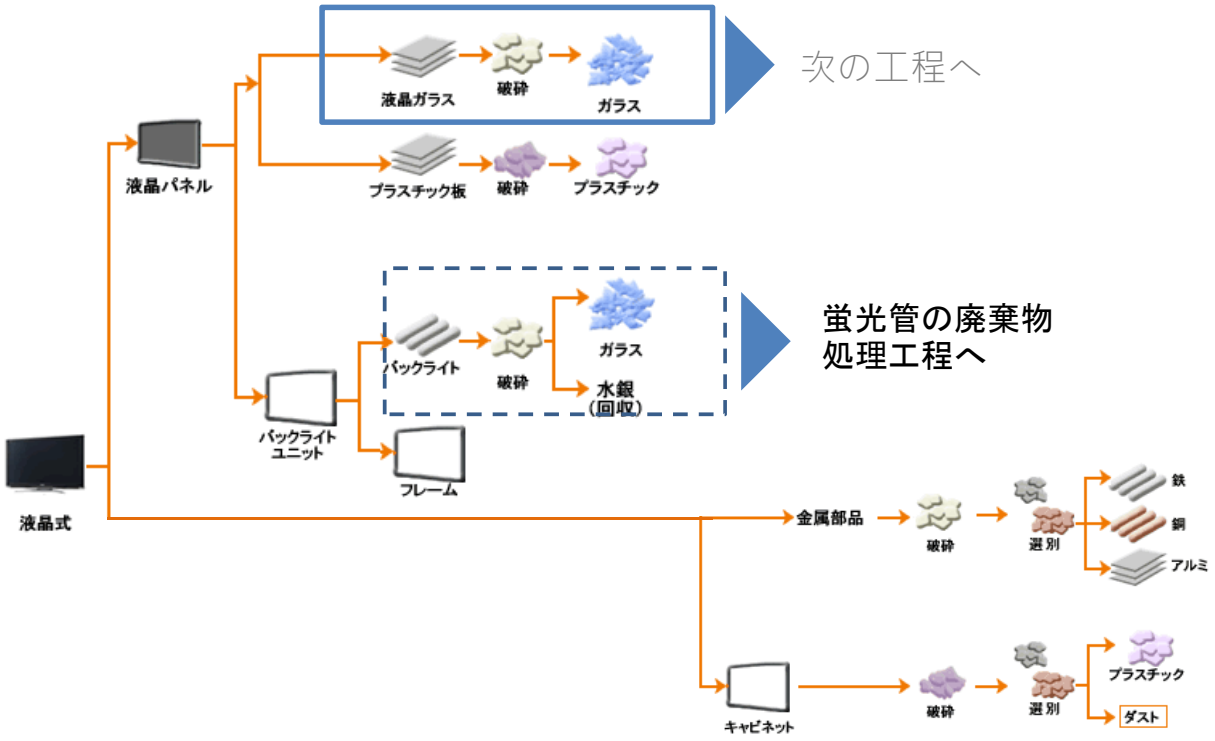
スズトクホールディングス株式会社



※　平成27年度版 家電リサイクル年次報告（一般財団法人家電製品協会）より引用

弊社における液晶テレビのリサイクル（4）

スズトクホールディングス株式会社



※　東芝ＨＰより引用
（http://www.toshiba.co.jp/kdnrc/technology.htm）

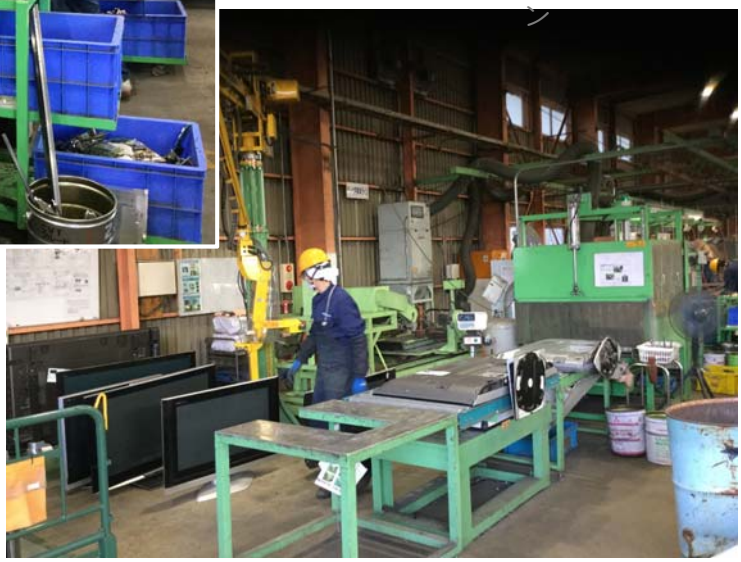
弊社における液晶テレビ等のリサイクル（1）

スズトクホールディングス株式会社

液晶ＴＶ手解体ライン

手解体

プラズマTV手解体ライン



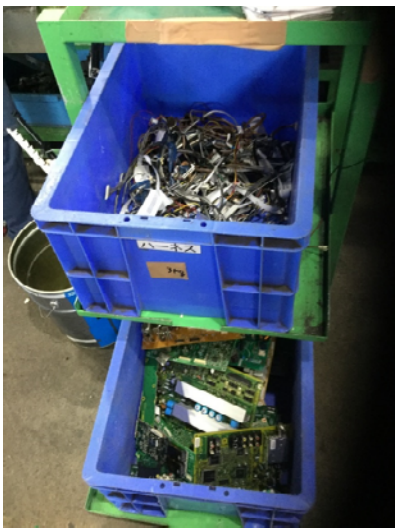
弊社における液晶テレビのリサイクル（2）

スズトクホールディングス株式会社

液晶パネル蛍光管（水銀含有）

蛍光管取り外し　簡易ドラフトチャンバー
（水銀対策）

回収物１
（アクリル板・拡散板
・液晶パネル）



回収物２
（基板・ハーネス）

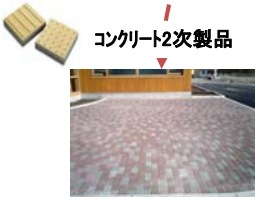
回収物３
（フレーム等）

次工程へ

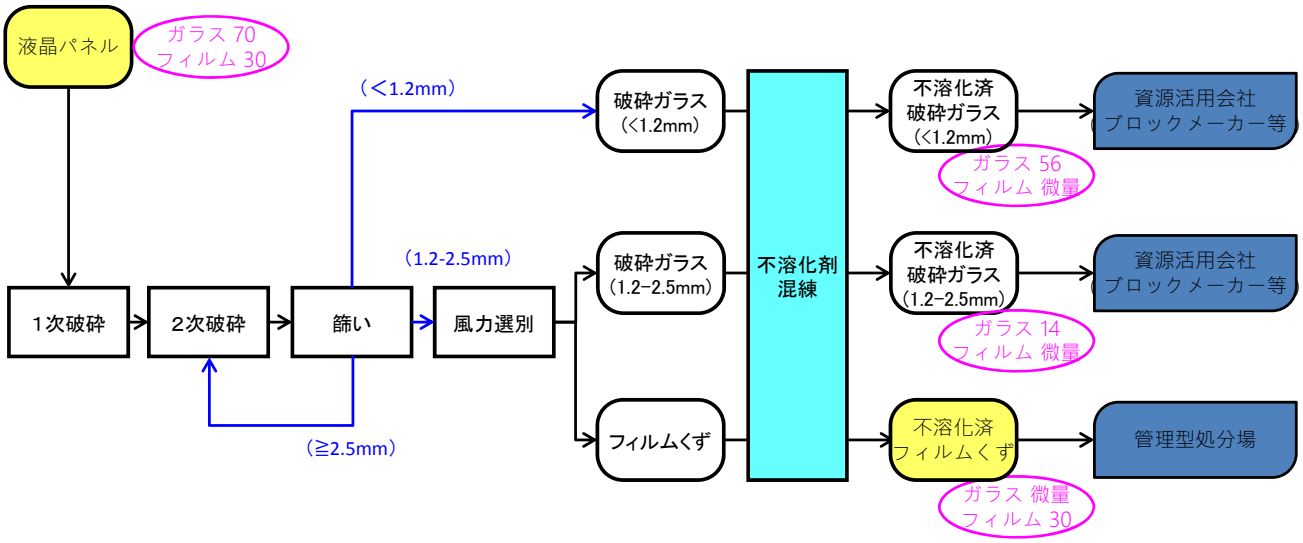
経済産業省の補助を受け、
現状の溶融処理とは全く異なる、マテリアルリサイクルシステムを開発

RTJ Recycle Tech Japan

≪液晶パネル
リサイクルライン≫
処理能力　80t/月



液晶パネルの処理フロー



•図中に示したガラスとフィルムの比率は直近のおよその実績である。
入荷するＬＣＤパネルと処理条件の組合せによって変動する。

・液晶パネル　不溶化済フィルムくず　は、逆有償取り引き

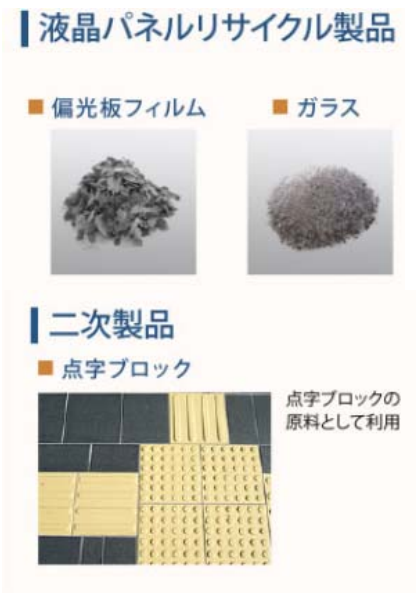
粉砕ガラス排出部

破砕選別ライン全景

パネル投入作業

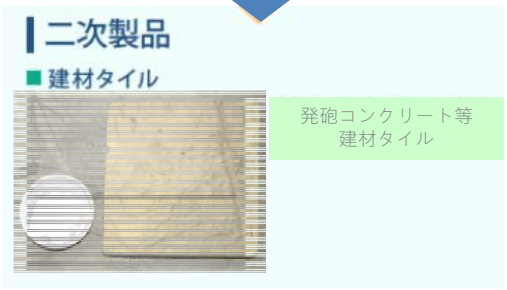
リサイクル技術の先行例（リサイクルテック・ジャパン）（３）

使用済み液晶パネルのリサイクル



※　リサイクルテックジャパン株式会社ＨＰより引用
（http://www.r-t-j.co.jp/index.php）

ガラスパウダー製造装置（微粉砕）



ガラス廃材

まとめ

・現在、液晶パネル等の再商品化率は８４％と、法律で定める再商品化率（７４％）を大きく上回っていますが、液晶テレビのパネル部分のマテリアル利用率はまだまだ低い状況にあります。
パネル部分のサーマルリサイクルからの転換。
リサイクルガラスの市場開拓が今後の課題と捉えています。

スズトクホールディングス株式会社

ご静聴ありがとうございました。

Thank you for your attention

【参考】　大手製造業者等による料金引下げの例

スズトクホールディングス株式会社

消費者の支払う費用＝
収集・運搬料金（各小売業者が設定）＋リサイクル料金

消費税
5%→8%

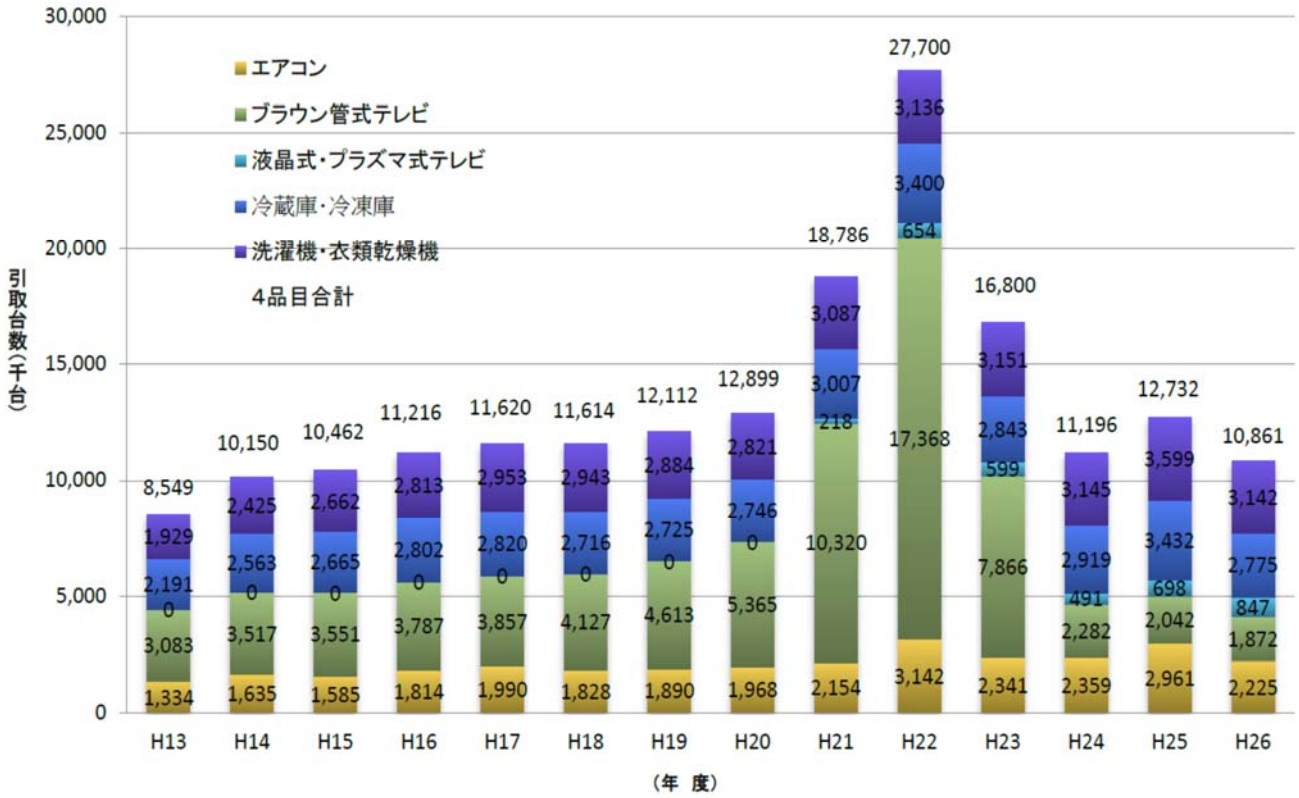
品目	区分	法施行時	1998.4.1～	2008.11.1～	2011.4.1～	2013.4.1～	2014.4.1～	2015.4.1～
エアコン	-	¥3,675 ₩38,992	¥3,150 ₩33,422	¥2,625 ₩27,851	¥2,100 ₩22,281	¥1,575 ₩16,711	¥1,620 ₩17,188	¥972 ₩10,313
テレビ	大 (16型以上)	¥2,835 ₩30,079	→	¥2,835 ₩30,079	→	→	¥2,916 ₩30,939	¥2,916 ₩30,939
	小 (15型以下)		→	¥1,785 ₩18,939	→	→	¥1,836 ₩19,480	¥1,836 ₩19,480
冷蔵庫・冷凍庫	大 (171ℓ以上)	¥4,830 ₩51,246	→	¥4,830 ₩51,246	→	→	¥4,968 ₩52,710	¥3,672 ₩38,960
	小 （170ℓ以下）		→	¥3,780 ₩40,106	→	→	¥3,888 ₩41,252	¥4,644 ₩49,273
洗濯機・衣類乾燥機	-	¥2,520 ₩26,737	→	→	→	→	¥2,592 ₩27,501	¥2,484 ₩26,355

※　家電リサイクル制度の施行状況の評価・検討に関する報告書（平成26年10月）より作成

(\1=₩10.61換算)

【参考】製造業者等の指定引取場所における引き取り台数の推移

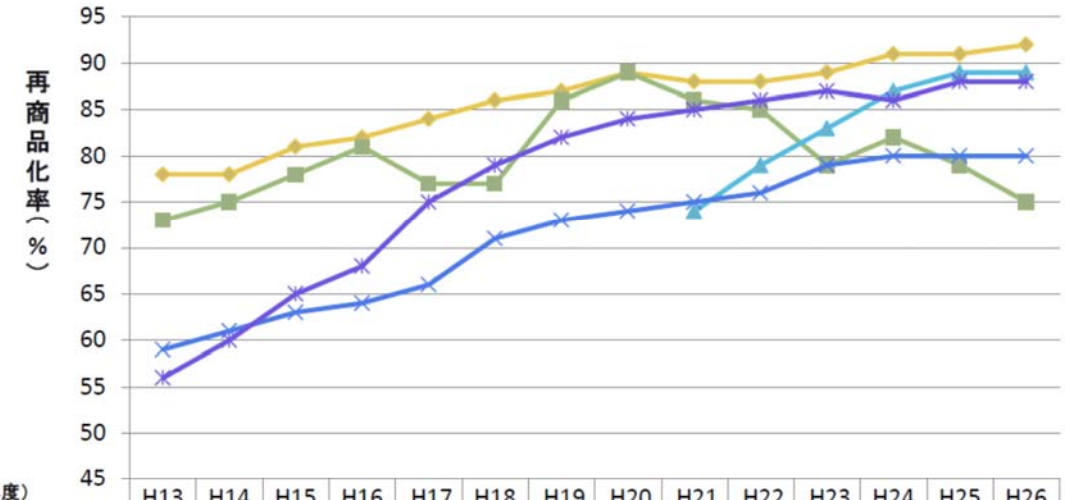
スズトクホールディングス株式会社



※　平成26年度版 家電リサイクル年次報告書（一般財団法人家電製品協会）より引用

製造業者等における再商品化率の推移

スズトクホールディングス株式会社



（年度）	H13	H14	H15	H16	H17	H18	H19	H20	H21	H22	H23	H24	H25	H26
エアコン	78	78	81	82	84	86	87	89	88	88	89	91	91	92
ブラウン管式テレビ	73	75	78	81	77	77	86	89	86	85	79	82	79	75
液晶式・プラズマ式テレビ									74	79	83	87	89	89
冷蔵庫・冷凍庫	59	61	63	64	66	71	73	74	75	76	79	80	80	80
洗濯機・衣類乾燥機	56	60	65	68	75	79	82	84	85	86	87	86	88	88

※　平成26年度版 家電リサイクル年次報告書（一般財団法人家電製品協会）より引用

【参考】 リサイクル技術

スズトクホールディングス株式会社

・サイズによる構造の違いは少なく、同一工程でリサイクルが可能。
・サイズが大型化するとビスが増えることにより、解体に時間がかかる。また、反転させるために人員やハンドリング治具などの設備が必要。

	液晶テレビ	プラズマテレビ
工程の差異	基本的にサイズによる工程の違いはない。（13V型から70V型まで）	基本的にサイズによる工程の違いはない。（32V型から65V型まで）
	分解処理時間はほぼビスを外す本数に律速である（大型化するほど解体に時間がかかる）	
	一定の大きさを（おおよそ37V型以上）を超えると、ビスを外す時に製品を反転させるなどの追加作業が必要となる。	
	サイズが大型化すると、取り外す蛍光管が増える。また長さも長くなり慎重な作業が必要。	

※　中央環境審議会廃棄物・リサイクル部会　特定家庭用機器の再商品化・適正処理に関する専門委員会（第３回,2008.5.13）より作成

BLUBOX:
THE TECHNOLOGY FOR THE RECYCLING OF FLAT PANEL DISPLAYS AND LAMPS

Guilhem Grimaud, MTB Recycling, France

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Symposium on eco-friendly recycling technologies of end-of-life Flat Panel Display

Seoul, November 2, 2016

CONTENTS

1 INTRODUCTION

Presentation of MTB Company

Presentation of MTB Company trades

Machines de Triage et de Broyage
Sorting and shredding solutions

MTB RECYCLING MANUFACTURING ENGINEERING
- More Than Business -

- Complex wastes recycling
- Machines Manufacturing for sorting and shredding
- Recycling Solutions integration and engineering

INTRODUCTION

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

MTB 3 Main Activities

MTB Waste Recycling

– 5 dedicated lines: aluminium, e-waste, copper, plastics and shredding residue
– 40,000 t waste recycled at the MTB facility in Trept, France

MTB Machines Manufacturing

– Shredding solutions: rotary shears, shredders, granulators
– Separation equipment: air density tables, sieving tables
– Eddy Current separators and magnetic separators
– Containerised solutions: Blubox, CableBox and TyreBox

MTB Recycling Solutions Engineering

– Turnkey recycling facilities for: cables, e-waste, tyres, shredding residues, plastics, bottom ash, etc.
– Custom solutions: synthetic grass, carbon honeycomb, batteries, munitions, etc.

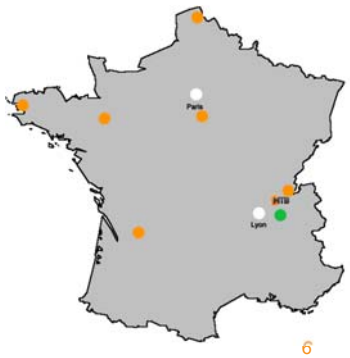
INTRODUCTION

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

MTB Company in Brief

- **35 years of experience (foundation in 1981 in France)**
- **Revenue 65 M€ annually**
- **120 employees including 45 engineers and researchers**
- **10,000,000 t waste recycled annually**
- **With over 1,500 MTB machines operating worldwide**



2 ORGANISATION OF FPD RECYCLING

Case study in France

MTB

ORGANISATION OF FPD RECYCLING IN FRANCE

E-Waste Categories in Europe

	Categories until 2018	New categories from 2018
1	Large household appliances cold and non cold (LHA)	Heat exchange equipment
2	Small household appliances (SHA)	Monitors, and equipment containing screens
3	IT Equipment and Telecommunications	Lamps
4	Consumer equipment	Large equipment
5	Lighting Equipment	Small equipment
6	Electrical and electronic tools	Small IT and telecommunications equipment
7	Toys, leisure and sports	Photovoltaic panels
8	Medical devices	
9	Monitoring instruments and control	
10	Automatic dispensers	
11	Photovoltaic panels	

ORGANISATION OF FPD RECYCLING IN FRANCE

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

Major Actors of Extended Producer Responsibility in France

Eco-Organisations Manage for the Account of Producers:

– Removal, sorting, decontamination and recycling of equipment selectively collected

– They organise, but they are not players of the recycling value chain.

In France, 3 Eco-Organisation Bodies are Approved for E-Waste:

– Eco-Organisations perform call for tenders each year to recycling facilities

– Main decision factor: economic payback

– Eco-Organisations are responsible for audits and controls.

ORGANISATION OF FPD RECYCLING IN FRANCE

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

Data on the E-Waste Sector in France

In 2013, French Environment Agency (ADEME) account:

– 5,500 Producers of household equipment and 1,600 Producers of professional equipment.

WEEE placed on the household and professional market in 2013:

– 622 million equipment, or about 1.55 million tonnes (24 kg/Capita/year).

– Deposit household WEEE estimated between 17 and 23 kg/Capita/year.

– Eco-contributions for household WEEE: €160 million in 2013.

Household E-Waste collection

– 455,000 tonnes in 2013, 6.9 kg/Capita/year.

– More than 4,500 points by local authorities and 22,900 collection points ‘distributors’.

– Nearly 17,000 collection points for lamps in 2013.

Treatment of household WEEE: 453,000 tonnes in 2013, 79% were recycled.

ORGANISATION OF FPD RECYCLING IN FRANCE

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

E-Waste Directive: European Recovery Targets

Recycling and recovery targets given by category:

- Cat 1 and 10 (large equipment and ATMs): 80% recovered, 75% recycled
- Cat 3 and 4 (telecom equipment): 75% recovered, 65% recycled
- Cat 2, 5–9 (lamps, WFP and the general public): 70% recovered, 50% recycled.

The EU is still far from its collection targets of WEEE

- European average: 35% in 2014 (source UN) - 85% target in 2019
- Production of 9.5 million tons generated in Europe, only 3.3m tons collected.
- Many unsorted waste but also major export to Africa and Asia.

3 BLUBOX

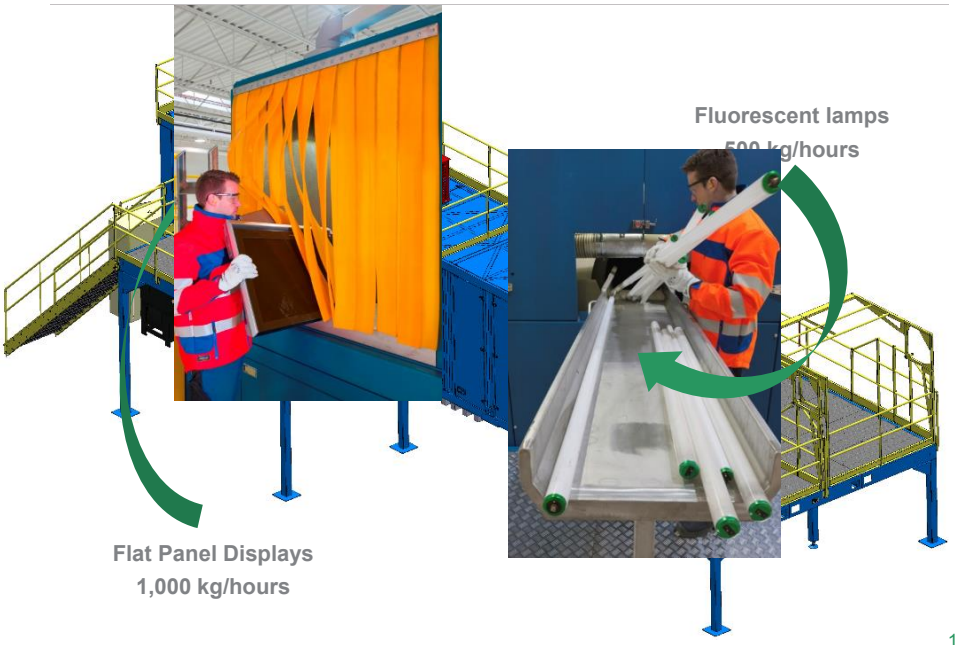
Mechanical solution for FPD Recycling

MECHANICAL SOLUTION FOR FPD RECYCLING

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

Overview of the BLUBOX Solution

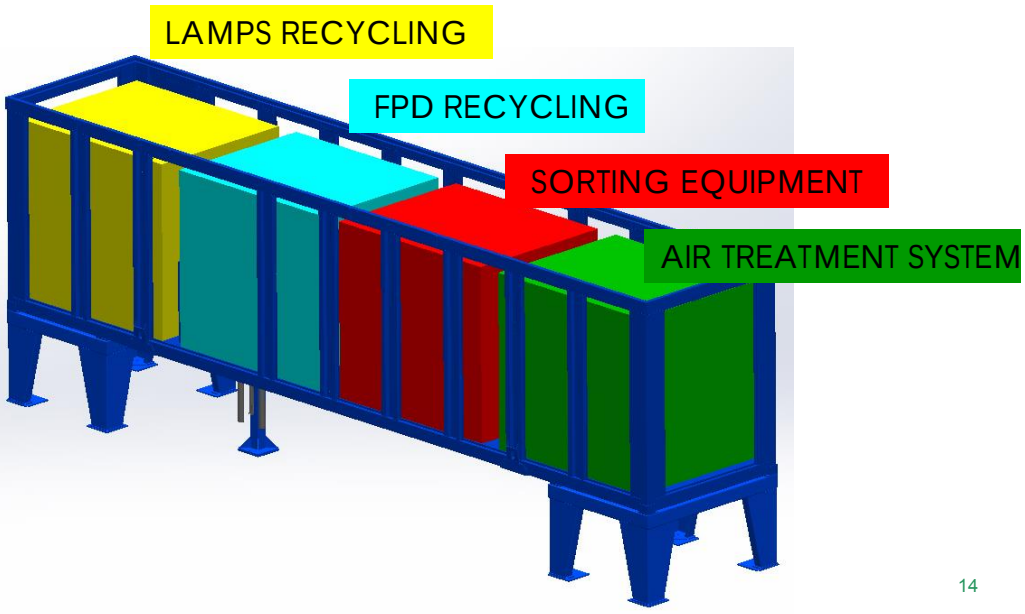


MECHANICAL SOLUTION FOR FPD RECYCLING

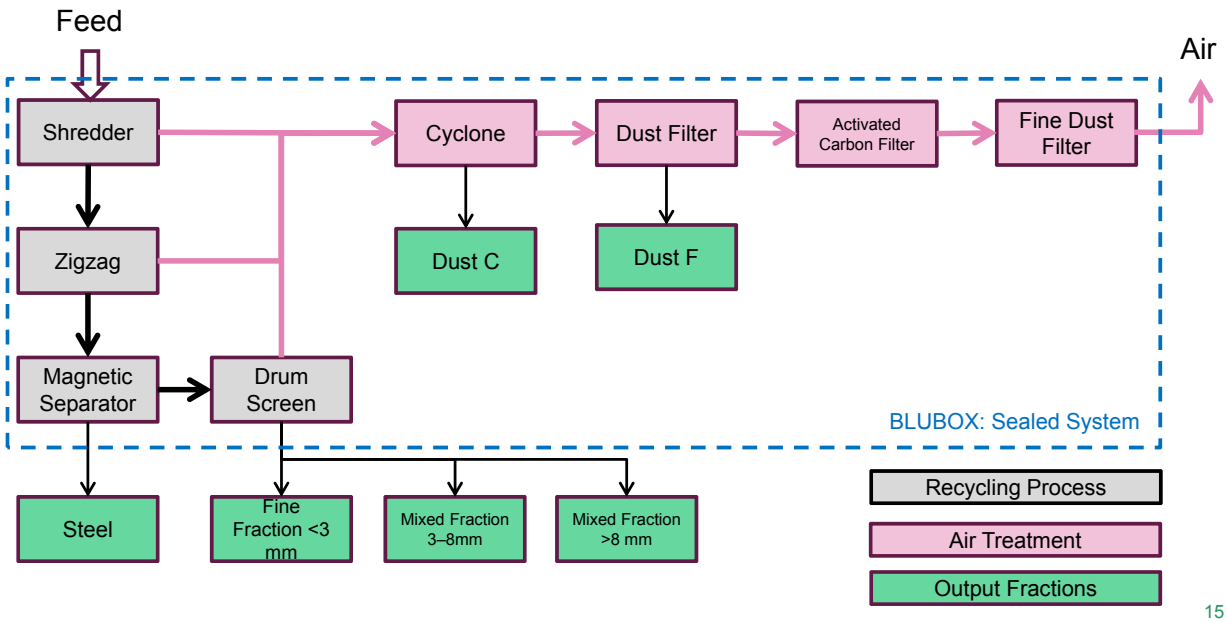
BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

The All-in-One Solution in a 40 ft Container



Flow chart FPD Recycling in BLUBOX

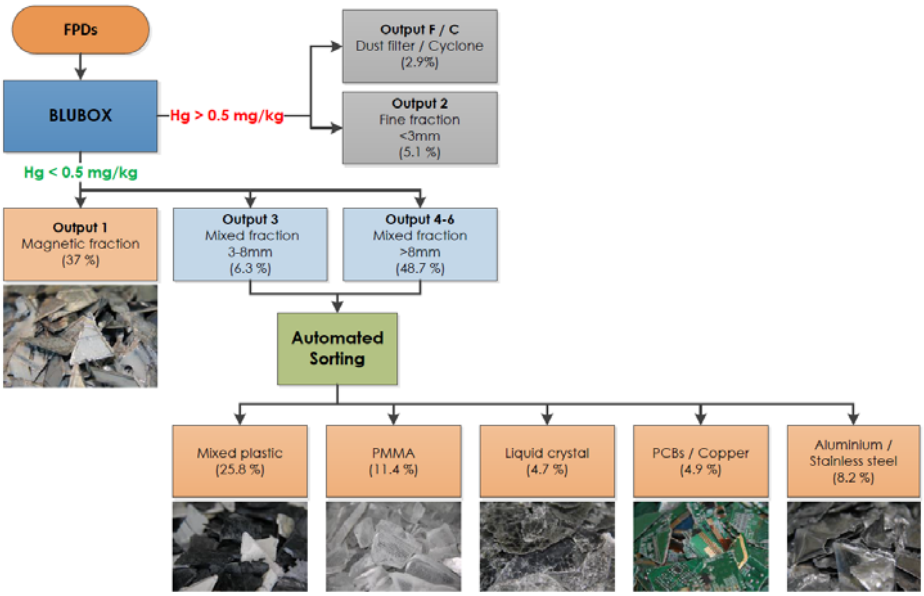


MECHANICAL SOLUTION FOR FPD RECYCLING

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

The Output Fractions from FPD



MECHANICAL SOLUTION FOR FPD RECYCLING

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

Main Advantages of the BLUBOX solution

- **Safe, secure and sustainable solution for the recycling of lamps and FPD**
- **Mercury compounds are treated and retained inside the BLUBOX**
- **The BLUBOX meets the standards: R2, e-Steward WEEELABEX and CENELEC**
- **BLUBOX is already operating in 5 countries**

4 SORTING THE MIXED FRACTIONS

Optical and magnetics solutions

SORTING THE MIXED FRACTIONS

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

Valuable, High Quality Fraction Through Sorting

Output	Description	Output (%)	Hg (mg/kg)	Hg max. Value (mg/kg)	Downstream
Output 1	Steel	37	0.1	< 1	Steelworks
Output 2	Fine Fraction <3mm	5	2.5	< 10	Precious metals recovery (e.g. Umicore, Aurubis, others)
Output 3	Mixed Fraction 3-8mm	6	0.1	< 1	Sorting in various Fractions. Sales to the dedicate plants
Output 4/5/6	Mixed Fraction >8mm	49	0.1	< 1	
Dust C	Fine dust	3	5.6	< 10	Incineration, Landfill
Dust F	Fine dust		1.7	< 10	Incineration, Landfill

- Audit was performed by EMPA on 15 October 2013
- Analyses were made by EMPA Analytical Chemistry Laboratory

SORTING THE MIXED FRACTIONS

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

Valuable, High Quality Fraction through Sorting

Mixed Fraction 3-8 mm & Mixed Fraction >8 mm

Sorting Machine

Sorted Fractions


Aluminum


PCB's


PMMA


Mixed Plastics


LC-Glass

5 OTHER INFORMATION

Mercury Limit Values

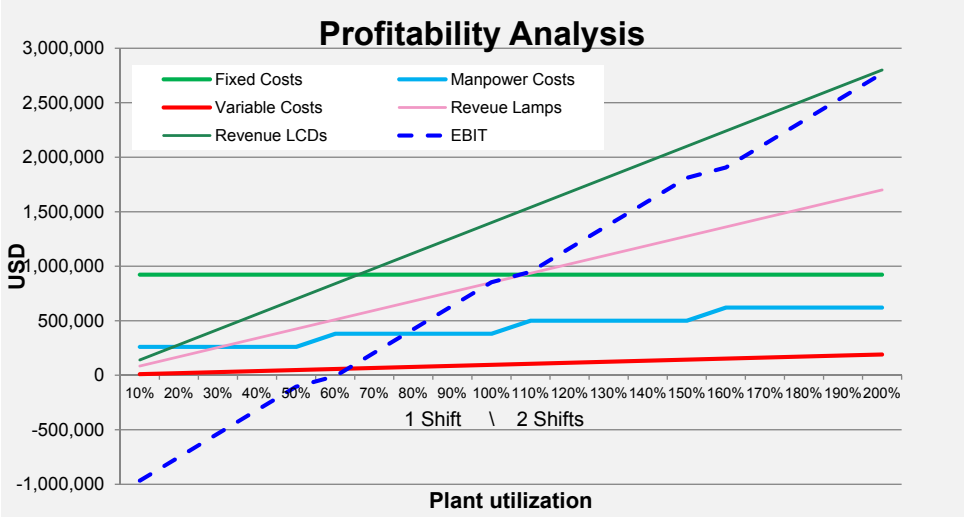
	Switzerland	France	Austria	USA
Air emission	0.2mg/m3 or 1g/h	0.02mg/m3	0.02mg/m3	0.1mg/m3
TLV Threshold limit value	0.05mg/m3	0.005mg/m3	0.02mg/m3	0.1mg/m3
FPD Fractions	10mg/kg (SWICO)	0.1% (0.5ppm WEEELABEX)	5mg/kg	0.2mg/l
Lamp Fractions	5mg/kg (SENS)	0.1%	5mg/kg	0.2mg/l

OTHER INFORMATION

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

Economic Model of BLUBOX



OTHER INFORMATION

BLUBOX

The Technology for the Recycling of Flat Panel Displays and Lamps

Commercial contacts

BLUBOX solutions are sold by:

- BLUBOX Trading SA
- Schwaderhof 7, 5708 Birrwil, Switzerland

- Andreas Krebs (CEO): Andreas.Krebs@blubox.ch and +41 627 851 003

BLUBOX solutions are manufactured by:

- MTB Recycling
- Quartier de la Gare, 38460 Trept, France

- Jean-Philippe Fusier (President): jp.fusier@mtb.fr and +33 474 928 768

THANK YOU FOR YOUR ATTENTION

g.grimaud@mtb.fr

Symposium on eco-friendly recycling technologies of end-of-life Flat Panel Display

Seoul, November 2, 2016

The Complete Solution to the Mercury Waste Problem

MRT System International AB

MRT System International AB

A Swedish company established in 1979.

MRT is recognised as the world leader in supplying complete lamp/mercury recycling systems. The unique technology is designed for processing a broad range of mercury bearing products.

The Swedish Invention

EPA requested recycling of heavy metals instead of disposal. All Swedish lamp producers had to follow the directive.

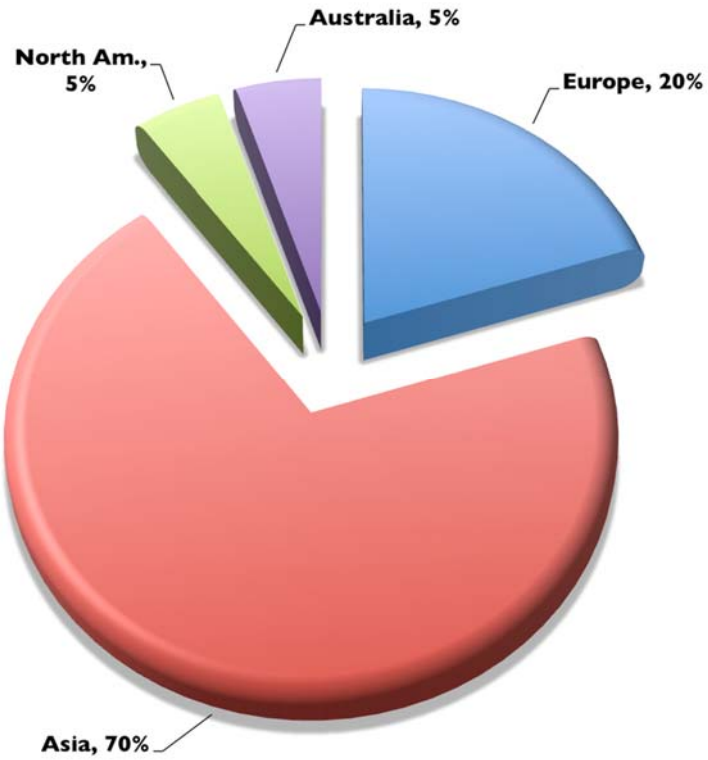
Development of the first distiller in 1975.

The first patent was issued in 1978.

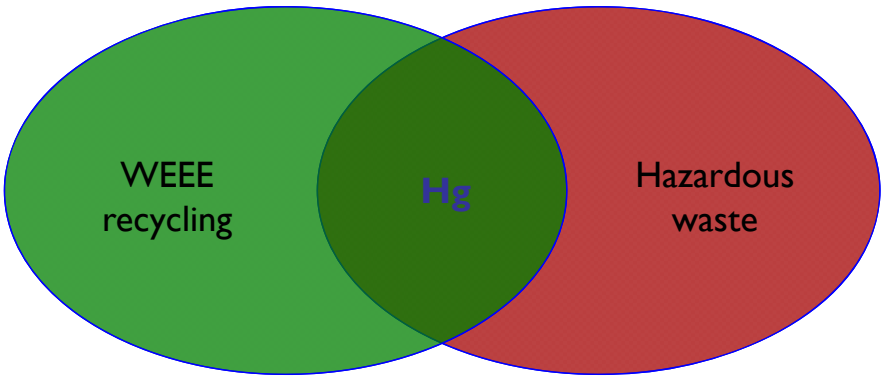
MRT Mission

MRT`s mission is to provide both lamp manufacturers and recycling companies world wide with solutions, machines and services that creates a profitable way of transforming mercury containing waste to non-hazardous and sellable products.

Sales statistics in geographic areas



MRT Business Model



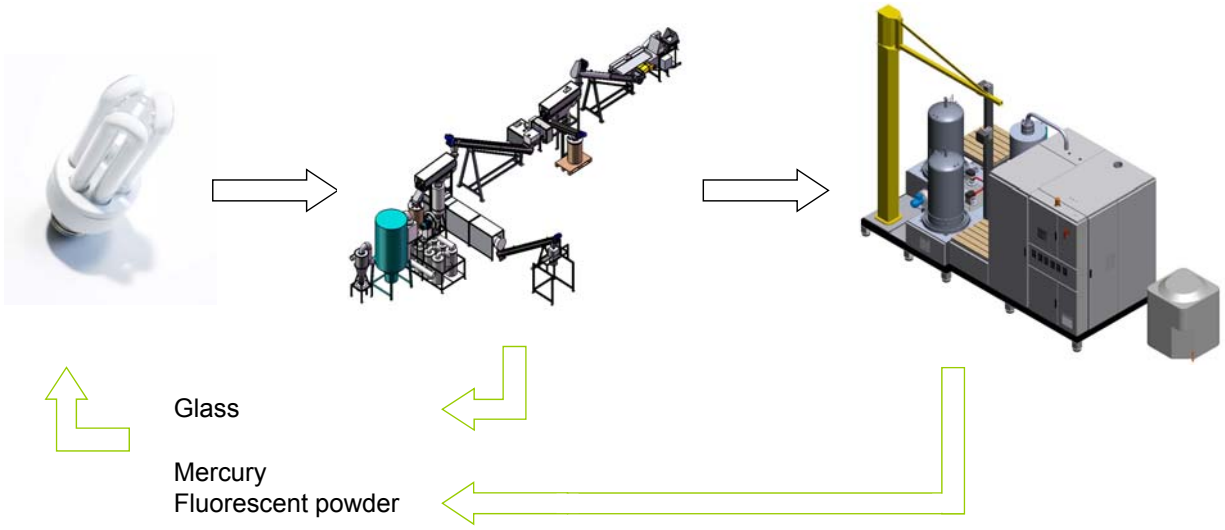
Europe, WEEE Directive

Waste of Electrical and Electronic Equipment

- The purpose of the directive is to prevent waste or to reduce waste by re-use or recycling.

- By August 13, 2005 all member states had to ensure that collection systems were set up. Producers of electrical and electronic equipment provides for the financing of collection, treatment and environmentally sound disposal. The polluter pays!
- By December 31, 2006 the member states must ensure a separate collection rate of 4kg per inhabitant and year.

Lamp Recycling



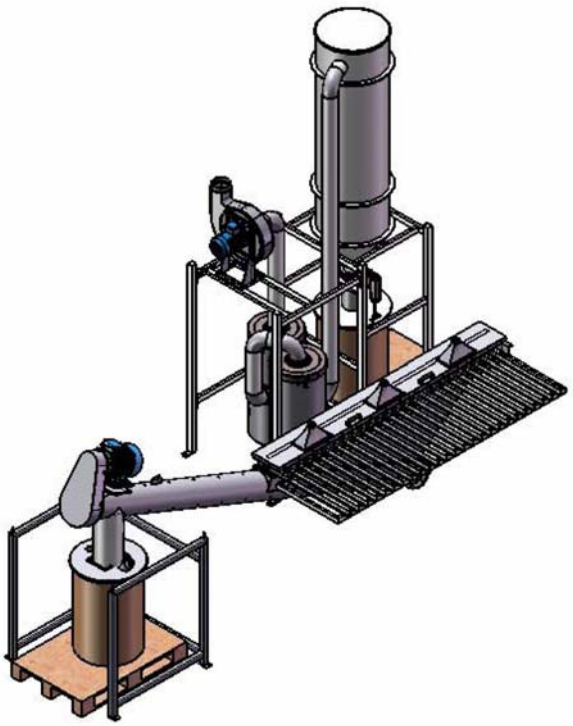
MRT Business Areas

Lamp recycling
- Crush & Separation Plant
- End Cut Technology

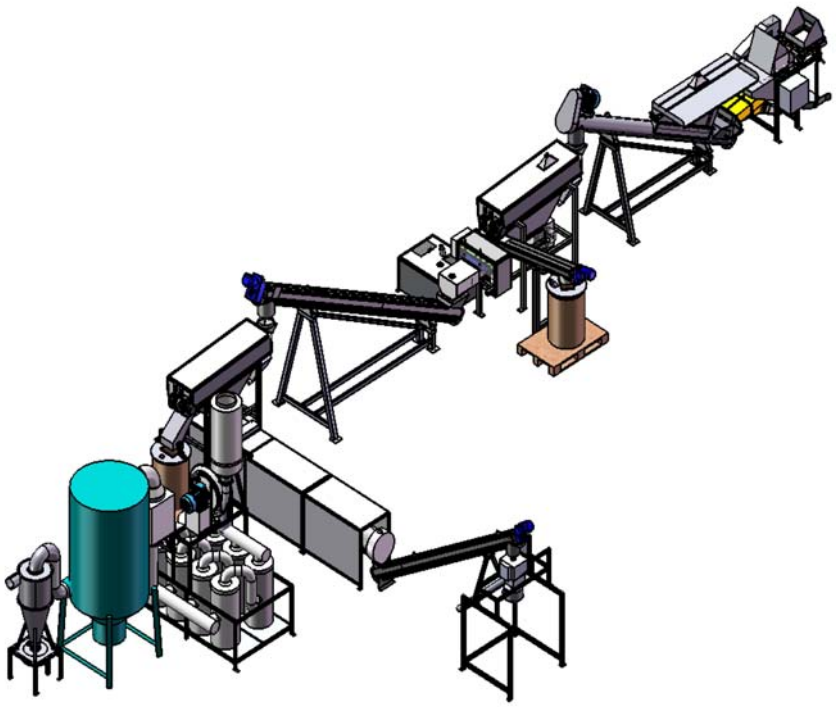
Mercury recovery
- Batch Distiller
- Continuous Flow Distiller

Electronical waste recycling
- LCD separation
- CRT-separation

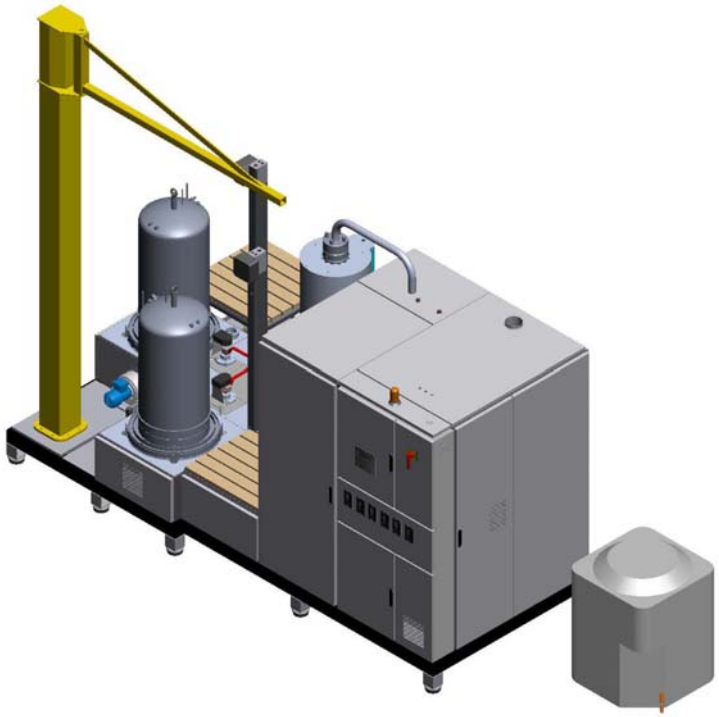
Lamp Crusher (LC1)



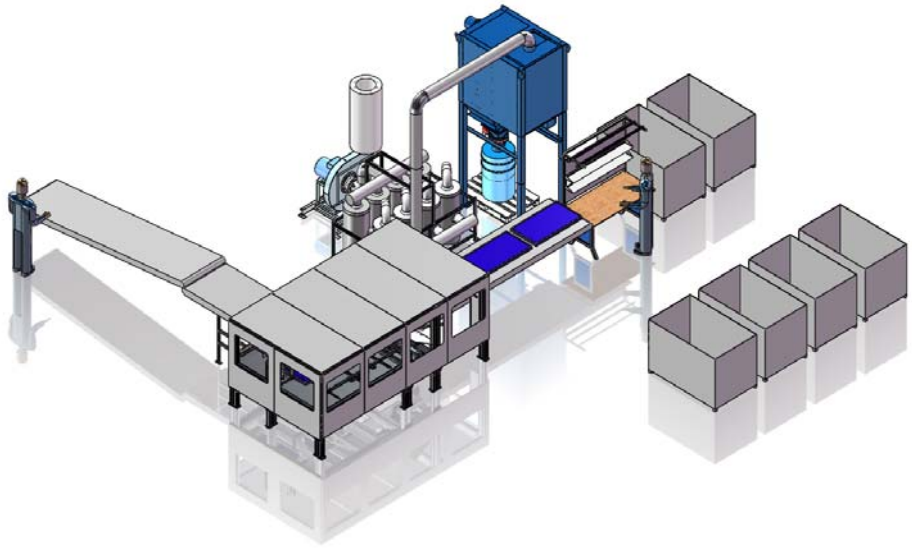
Lamp Processor 600 (LP600)



Batch Process Distiller (BPD)



Flat Panel Display Processor (FPP)



MRT System International A B

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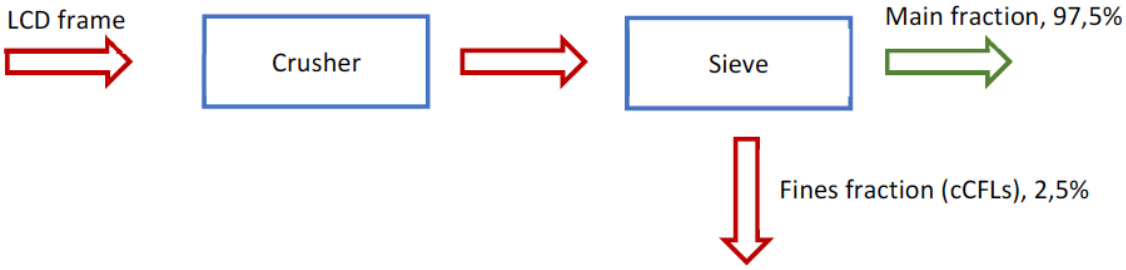
Lumavagen 1
37147 Karlskrona
Sweden

www.mrtsystem.com
info@mrtsystem.com

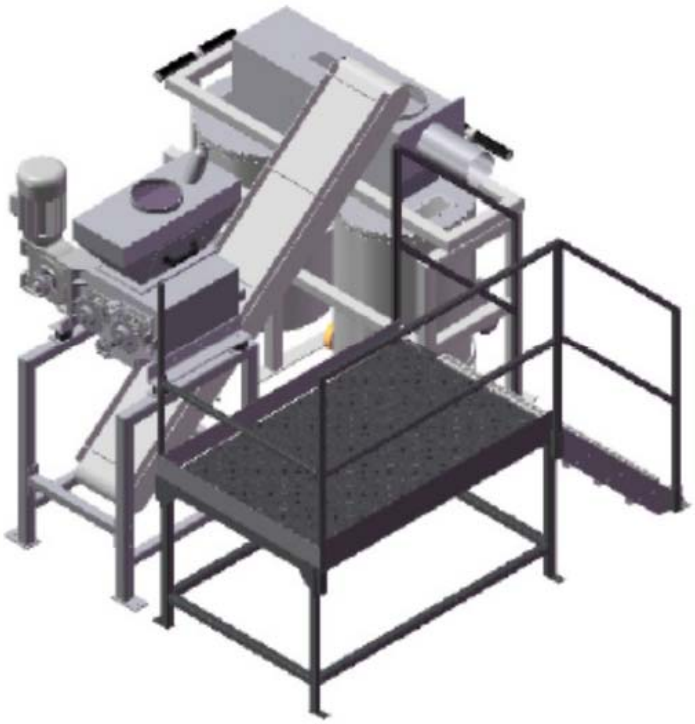
COT-60

MRT System International AB

Cut-Off Treatment (COT-60)



Cut-Off Treatment (COT-60)



Fractions COT-60

	Weight frame (g)	Part of frame (%)	Weight LCD (g)	Part of LCD (%)
Main fraction	2 388	97,55	2 388	14,63
Fines fraction	60	2,45	60	0,37
LCD panel (rest)			13 872	85,00
Total	2 448		16 320	

Fractions COT-60

FPP discharge

Main fraction 97%

Fine fraction 3%