附件三、國際電子廢棄物回收管理夥伴會議第二天簡報

2019 International E-waste Management Network Workshop
December 2-4, 2019

Science-Policy-Business Nexus Approach
Japanese Cases

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Self Introduction

- Yasuhiko Hotta, Chettipappan Visvanathan and Michikazu Kojima "Recycling rate and target setting: challenges for standardized measurement" *Journal of Material Cycles and Waste Management* 18(1) · February 2016.
- Aya Yoshidaa, Atsushi Terazonoa, Florencio C. Ballesteros Jr.b, Duc-Quang Nguyenc, Sunandar Sukandard, Michikazu Kojima, Shozo Sakatae, "E-waste recycling processes in Indonesia, the Philippines, and Vietnam: A case study of cathode ray tube TVs and monitors" *Resources Conservation and Recycling* 106:48-58 · January 2016
- Kojima, Michikazu, Aya Yoshida and So Sasaki, "Difficulties in applying extended producer responsibility policies in developing countries: case studies in e-waste recycling in China and Thailand", *Journal of Material Cycles and Waste Management*, 2009, Volume 11, Number 3, Pages 263-269, Springer.
- Atsushi Terazono, Shinsuke Murakami, Naoya Abe, Bulent Inanc and Michikazu Kojima, et al." Current status and research on E-waste issues in Asia", *Journal of Material Cycles and Waste Management*, 2006, Volume 8, Number 1, Pages 1-12, Springer.

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Contents

- Concern on E-waste in Japan
  - Improper Treatment of Shredder Dust of E-waste and ELV
  - Increase of Treatment cost in Japan
  - To Prevent Fires from Scrap Yard
- Pollution from E-waste Recycling
- Competition between Formal and Informal Recycler
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Concern on E-waste in Japan

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Shift of Major Issues on E-waste in Japan

Late 1960s-1970s
- Difficulty to treat e-waste by local government. Improper recycling, causing pollution (not well reported).
- Tokyo Metropolitan government considered to put responsibility of treating e-waste on producers. But not implemented.
- Pollution control regulation was introduced and enforced. Industrial waste was also regulated, but enforcement was weak.
- Oil Shock

1980s-Early 1990s
- Illegal dumping of residues from e-waste recycling
- Illegal dumping in Teshima
- Montreal Protocol regulating CFCs.
- Illegal dumping site was closed. Recyclers should

1990s
- Less E-waste collection by private sector. Rising Cost of Treating E-waste by local government.
- RoHS (Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (EU)
- Home Appliance Recycling Act (Enforced in 2001)

2000s -
- Export of Secondhand goods and E-waste mixed with other metal scraps. Fires from stockyard for mixed metal.
- Hike of price of rare metals
- Act on the Promotion of Recycling of Small Waste Electrical and Electronic Equipment (Enforced in 2013), Revision of Basel Act (Enforced in 2018), Registration of Stockyard and Standard for Stockyard

Beginning of Concern on E-waste Recycling

- In early 1970s, Tokyo Metropolitan Government considered to put responsibility of treating some wastes including e-waste on producers. The idea was not implemented.
- Due to Oil Shock, recycling were also highlighted.
- Manufacturers formulated Home Appliance Recycling Association in 1974, which was merged into Association for Electric Home Appliances, in 1980.
- Home Appliance Recycling Law was enacted in 1998, and entered into force fully in 2001.
- Before the law was enacted, various studies were conducted.
- Some of studies were conducted by private companies and industrial association.

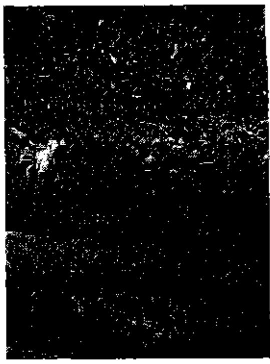
Improper Treatment of Shredder Dust of E-waste and ELV

Concern on E-waste in Japan

Improper Treatment of Residues form Recycling Process

- The most notorious illegal dumping case in Japan was Teshima Island case. From the early 1970s to 1990, more than 600,000 tons of waste including shredder dust of ELV and e-waste was illegally dumped on the island. A part of them were burned without pollution control measures.
- Police investigated the site in 1990 and stopped the operation. This case triggers the movement toward proper management of automobile recycling and home appliances.

Illegal Dumping site in Teshima



↑Activities to remove contaminated soil and remediate hazardous substances, which took 15 years until 2017. Treatment of contaminated water is still continued.
←The illegally dumped waste preserved in information center in Teshima. September 2015.

Academic Studies before Enactment of Home Appliance Recycling Law

- Sakamura, H et.al.(1995) "Elution of Toxic Elements from Waste Electric Appliances under Pseudo-environments" Environmental Science Vol.7, No.1 pp.35-41 (Japanese, with English abstract).
- Sakai, et.al. (1991) "Hazardous Materials in Shredder Wastes and their Appropriate Treatment System", *Journal of the Japan Society of Waste Management Experts*, Vol.3, No.2 pp.33-42 (Japanese, with English abstract).

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Studies by From Association of Industry

- Kamae, S. (1993) "Recycling of Wastes Caused by Used Electrical and Electronic Appliances" *Journal of the Japan Society of Waste Management Experts*, Vol.4, No.4, pp.295-303. (in Japanese, with English abstract)
- Matsumura, T. (1997) "A Recycle System of Used Electric Home Appliances" The Journal of Japan Institute for Interconnecting and Packaging Electronic Circuits, pp.76-78Vol.12, No.2 (in Japanese).

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Increase of Treatment Cost of e-waste

Concern on E-waste in Japan

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Increase of treatment cost by local government

- As economic development, amount of waste generated increases, waste contents become more complex. Local governments in Japan were bothered by the increase of waste treatment cost.
  - In early 1970s in Japan, Tokyo Metropolitan Government tried to impose waste collection and treatment responsibility on difficult waste such as plastic packaging, home appliances and tire. Although it was not possible to impose new responsibility on producers at that time, industries started to study the recycling technology and conduct pilot collection program in 1970s in Japan.
  - After various efforts to reduce waste were conducted by local government in 1980s and early 1990s in Japan, EPR systems was applied to packaging and container waste and specific home appliances around 2000.

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Treatment of hazardous substances

- As attention on environmental concern are growing, hazardous substances in e-waste should be handled carefully, recycled or disposed carefully.
  - Dust contaminated with hazardous substances, such as PBDE, which were used in TV and other home appliances.
  - CFCs, used in Air Conditioner and Refrigerator, are Ozone Depleting Substances.
  - Lead in solder
- These substances have been prohibited gradually, but some products being used still contain these substances.
- To protect occupational health and the environment, proper treatment is necessary.

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The necessity of cost sharing mechanism of new items

CFC collection from Air Conditioner, Akita, Japan, September 2009. Collected CFC were burned in incinerator, with pollution control.

- As technology developed, new materials and parts are used. It is likely that new materials and parts are not recycled in market basis.
- New materials and parts may damage environment, unless proper treatment is conducted. Additional cost sharing mechanism is needed.

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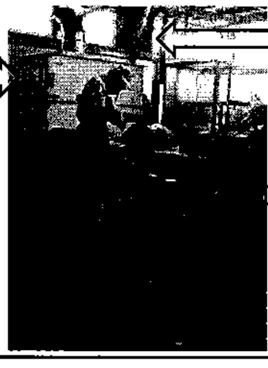
Dust Control in Home Appliance Recycling Company



Dust collection system is installed in home appliance dismantling facility in Tokyo, Japan, 2007.

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To Prevent Fires from Scrap Yard

Concern on E-waste in Japan

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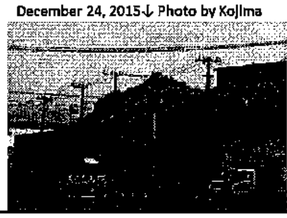
Fire of Metal Scraps

- The number of fire cases from mixed scrap yard has increased for 10 years.
- Metal Scrap frequently causes fires. In some cases, these fires have harmful effects on living environments, including bad odors and traffic related problems.
- It is difficult to identify causes of fires, but batteries which are mixed with other scraps are regarded as a trigger of fires.

December 18, 2015. Fire at metal scrap yard in Funabashi, Chiba. ↑.
December 24, 2015↓ Photo by Kojima



Scientific Research

- Some researches have been conducted.
  - FY 2008-1010 A research project by National Institute for Environmental Science, National Research Institute for Fire and Disaster, and others.
  - Cause of fire: It is difficult to identify the causes of fires in mixed metal scrap yard. But it is pointed out that batteries, especially Lithium Ion Battery, might be the cause of fires.

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To prevent fire

- Registration of Stockyard for e-waste and others which may contain hazardous substances.
- Guideline for Stockyard
  - To prevent soil contamination, apply appropriate measures such as concrete floor and drainage.
  - To prevent fire, properly segregate battery and oil. The height of pile of scarps should be controlled. etc.

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Pollution from E-waste Recycling

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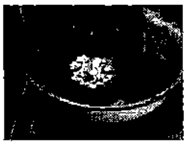
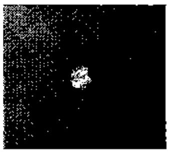
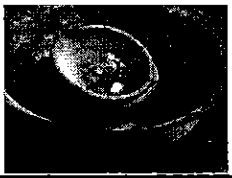
Recovering Gold from parts from IC tips of mobile phone

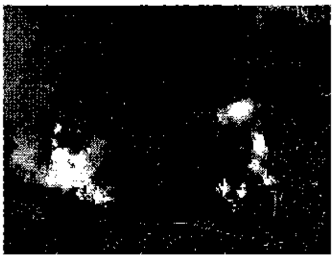

No control of emissions and effluents. Bandung Indonesia, September 2010.

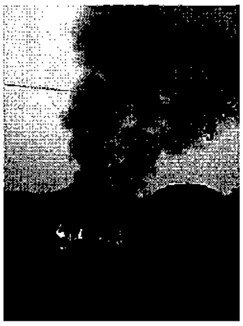
Extracting Gold and Silber from E-waste


By using cyanide and others, extracting gold and silver from e-waste and others, without pollution January 2012, Philippines.

Extract copper from coated cables



Burning coated cables to extract copper. Vietnam January, 2011.



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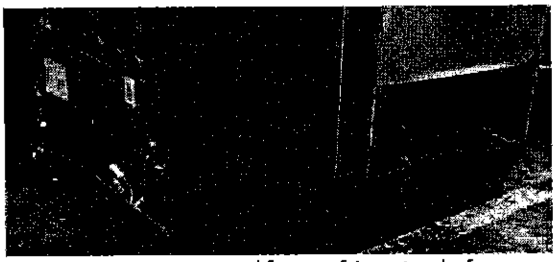
Emitted Refrigerant



- Compressor was removed from refrigerator, before waste refrigerators were delivered to e-waste recycling facility. Such practices is called, "cherry picking" or "Scavenging". It indicates that refrigerant was emitted to the air. (October 2017, Malaysia)

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Why is regulation on e-waste needed?

- Different backgrounds of e-waste recycling regulation can be observed
  - Pollution from recycling process
  - Improper treatment of residues
  - Increase of treatment cost by local government or recycler
- Regulations try to change responsibilities of stakeholders, cost sharing mechanism, and design of products, such as change of materials.
  - Various policies will be discussed in next lectures and other lectures in this course.

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Competition between Formal and Informal Recycler

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Competition with formal and informal recycler

- Formal recycler with pollution control and protection of labor safety, and informal recycler without appropriate protection measures are competing each other to collect e-waste.
- If enforcement of pollution control is weak, formal recyclers collect a limited volume of e-wastes, while informal recyclers collect large volume of e-wastes.

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Copper Cable Recycling

Open burning of plastic-coated wire to extract copper. Vietnam, August 2009.

Nagget system to separate copper and plastics, December 2012.

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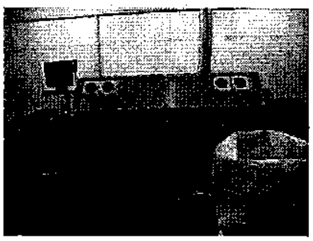
Removing IC tips from Printed Circuit Board



↑ Machines to remove IC tips and other parts from Printed Circuit Board, Hong Kong, December 2011. Removing IC them from Printed Circuit Board. Nov. 2011, Guang Dong, China

↑Removing IC tips and other parts from Printed Circuit Board. Nov. 2004, Guang Dong, China

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E-waste Recycling Facility in Nangjing, China

- Equipment to recover IC tip by melting solder and equipment to recover gold.
- With Motorola, program for collecting mobile phone is conducted in China. But it is short of collection.

December, 2004

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Pollution from Recycling System

- The major problem in recycling in developing Asian countries is dirty recycling .
- Even if formal recyclers invested in advanced facilities, they may face lack of waste for recycling, in market base recycling.
- Some policies should be implemented to change this situation.

← Extracting metals from Printed Circuit Board, Guiyu, China, (Nov. 2004)

← Dirty lead recycling which contaminate soil in Vietnam, (Dec. 2005)

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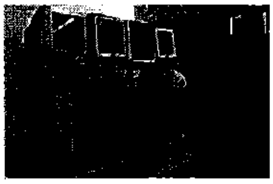
DIFFICULTIES APPLYING EPR IN DEVELOPING COUNTRIES

Examples of Orphan(1)

To implement EPR, it is necessary to identify producer or importer of goods. But if smuggled goods, imitated products and no brand products dominates market, it may be difficult to put responsibilities to all of producers and importers.

Probably, faked products, which design are same, but have LG logo and Sony logo. July 2007, in Vietnam.



No brand TV which are made from used TV monitor with new casing. Customer can choose brand name. January 2007, in China.

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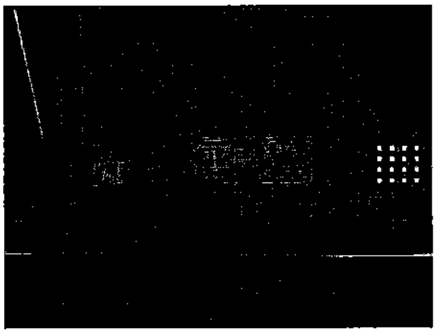
Example of Orphan(2)



Probably smuggled secondhand fax machine from Japan, found in secondhand market in Guangdong China. It is mentioned that customer service for this machine is only provided in Japan. Transformer is put into the machine.

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Volume of orphan

- It is difficult to estimate the volume of orphan.
  - According to an estimate, market share of unbranded air-conditioner, which are made by small manufacturer, was considered to be 20-30 % in Thailand early 2000s.
  - A survey conducted by NIES and Kyoto University in FY 2010 shows that more than half of desk top computer used in households in South Korea are unbranded one, which were made by small shops or by consumers by themselves.

Who bear the cost of orphan, instead of producer of orphan?

- Government
  - In packaging and container recycling regulation in Japan, small scale producer using packaging and container are exempted from bearing financial responsibility of producer. In stead of small scale producer, local government bear the recycling cost, because local government pay the cost of disposal of waste packaging and container.
- Consumer
  - In computer recycling system in Japan, consumer using orphan computer should pay recycling fee.

Reducing the volume of Orphan

- It is the responsibility of government to reduce some type of orphan such as smuggled products, imitated products and unregistered products, if appropriate regulation exists. One of the option is to collect recycling fee from them, if the government caught them.

Scavenging / Cherry Picking

Some parts are removed from e-waste, before formal recyclers receive e-waste. (2005, Taiwan)

- E-waste collector may remove valuable parts, before e-waste is sent to formal recycling company. It is called, scavenging.
- Scavenging may reduce the benefit of formal recycler.

What kind of measures can be implemented to reduce scavenging?

- If parts removed in advance to send e-waste to formal recycler are recycled without environmentally sound technology, collection system should be carefully designed.
- Buying price of e-waste without some parts should be lower than e-waste without missing parts.

Conclusion

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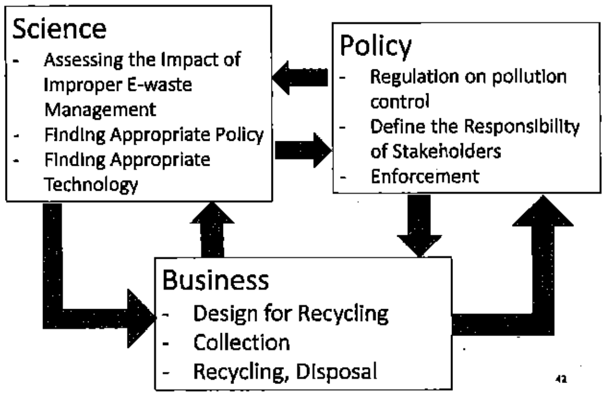
Science Policy Business Nexus



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Circular Economy, E-Waste and the Informal Sectors

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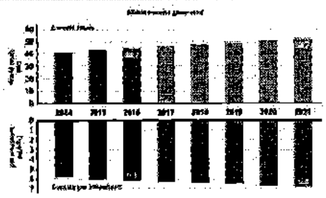
Outline

I. Global E-waste Statistics – Current Status and Future Trends

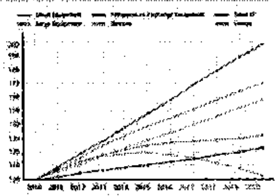
- According to most recent statistics provided by *The Global E-waste Monitor 2017* (Baldé , et al., 2017) , the world produced about **44.7 million tonnes** of e-waste in 2016.
- Global e-waste is expected to grow continuously, with an annual growth rate of 3 to 4%, which will reach **52.2 million tones** by 2021.



Source : Baldé, C.P., Forti V., Gray, V., Kuehr, R., Stegmann,P. : The Global E-waste Monitor 2017, United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Vienna.

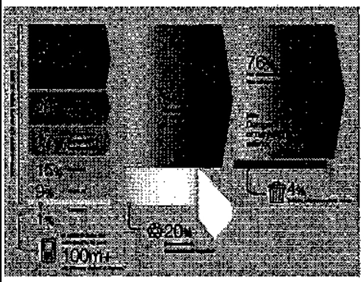
I. Global E-waste Statistics – Current Status and Future Trends

- This report classified e-waste into 6 categories, and each category shows an increasing trend from 2010, with the exception of the waste from screens, which begins to declines in 2015 when the replacement of CRT screens to flat panel comes gradually to an end.
- It is shown that waste from temperature exchange equipment and small and large equipment are having the largest growth rates and is expected to grow in the future.
- IT waste is expected to grow less quickly, due to the effects of miniaturization.



Source : The Global E-waste Monitor 2017, p.40.

Global E-Waste Flows



- E-waste recycling rates are low. With the 44.7 Mt of e-waste generated globally in 2016, only 20% (8.9 Mt) is verified to be collected and properly recycled. The other 80% of the e-waste is not documented. It is estimated that a total of 1.7 Mt of e-waste is disposed directly to the waste bin. The other 34.1 Mt of e-waste is untraced and unreported. It is probably dumped, traded, or recycled by the informal sector.

Source: World Economic Forum, A New Circular Vision for Electronics–Time for a Global Reboot, 2019

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Potential Value of raw materials in E-waste in 2016—54,827 Million €

Material	Kilotonnes (kT)	Million €
Fe	16,283	3,582
Cu	2,164	9,524
Al	2,472	3,585
Ag	1.6	884
Au	0.5	18,840
Pd	0.2	3,369
Plastics	12,230	15,043
Total	33,151	54,827

E-waste generation and collection by region

Indicator	Africa	Americas	Asia	Europe	Oceania
Countries in region	53	35	49	40	13
Population in region (millions)	1,174	977	4,416	738	39
WG (kg/inh)	1.9	11.6	4.2	16.6	17.3
Indication WG (Mt)	2.2	11.3	18.2	12.3	0.7
Documented to be collected and recycled (Mt)	0.004	1.9	2.7	4.3	0.04
Collection Rate (in region)	0%	17%	15%	35%	6%

- Europe and the US alone contribute to almost one-half of the total e-waste generated annually.
- E-waste contains precious metals and rare earth materials including gold, silver, copper, platinum, palladium, iron and aluminum, along with plastics that can be recycled.
- Potential value of raw materials in mobile phone waste is 9.4 billion euros in 2016.
- Overall, UNU estimates that the resource perspective for secondary raw materials of e-waste is worth 55 Billion € of raw materials. But this value remains largely unexploited due to a lack of concerted public-private efforts.

Source: The Global E-waste Monitor, 2017, p.41 and p.54.

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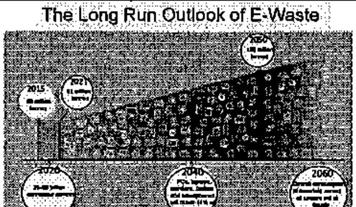
The Long Run Outlook of E-Waste



Source: World Economic Forum, A New Circular Vision for Electronics Time for a Global Reboot, 2019

- A long run estimation made by the World Economic Forum indicated a worst-case scenario of future e-waste generated by 2050 to be more than doubled to 120 million tones annually.
- With the current low recycling rate, a huge amount of precious materials are to be wasted, so does the market value of these resources which will be left untapped.

II. The Informal Sector in E-waste Recycling

- The term 'informal' has often been characterized as being beyond the reach of different levels and mechanisms of official governance, lacking in regulation, structure and institutionalization, and as non-registered and illegal. These enterprises are not formally charged with the services they provide, and no contract exists between self-employed workers and enterprises of the informal sector and the local government. They work without licenses. IS enterprises do not pay commercial, income or any other type of taxes and they do often not consider legislation on employment and environmental protection.
- Similar e-waste management problems exist in developing countries which includes:
  - lack of adequate public awareness;
  - lack of government policy and legislation
  - lack of an effective take-back/collection system and EPR system;
  - dominance of the recycling sector by an uncontrolled, ill-equipped informal sector that pollutes the environment; and
  - lack of adequate recycling facilities, and poor financing of hazardous waste management activities.

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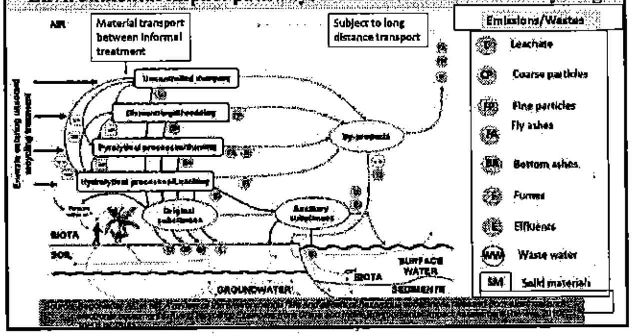
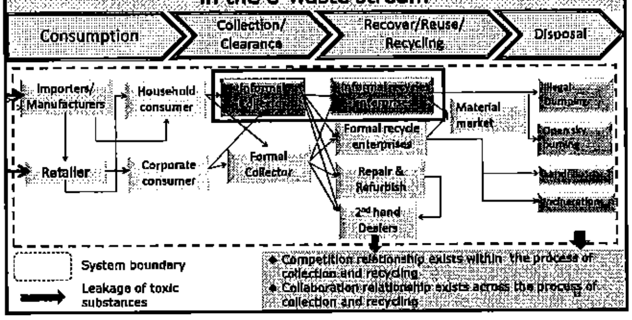
Environmental impact pathways from informal e-waste recycling



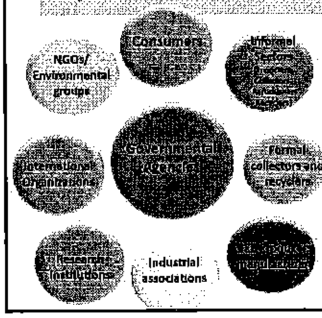
II. The Informal Sector in E-waste Recycling

- van de Klundert and Lardinols (2015):
  - Grey zone exists between the formal and informal sector that both sectors are involved in the collecting and recycling activities;
  - There are relatively strong commercial connections exist between the enterprises, with the 'informal' enterprise acting as supplier or subcontractor to a 'formal' sector;
  - Competition for both materials and service contracts may exist between the two sectors.

Informal sector with other main participants in the e-waste stream



Key stakeholders in e-waste recycling system



Comparison of formal and informal sectors

Characteristics	Formal Sector	Informal Sector
Motivation	✧ Potential profit	✧ Survival ✧ Need for subsistence activities
Economic	✧ Higher cost ✧ Lower revenue	✧ Lower cost ✧ Higher revenue
Technical	✧ Comprehensive ✧ Automated technology ✧ Capital/energy intensive technology	✧ Rudimentary technology ✧ Labor intensive ✧ Manual dismantling
Environmental	✧ Sound ✧ External costs internalized ✧ private cost	✧ Polluting ✧ Externalized pollution ✧ social cost
Legislature	✧ Authorized/legal	✧ Illegal
Market	✧ Developing, relatively immature	✧ Matured network
Social image/cultural	✧ Industrialized/ advanced technology ✧ Sustainable	✧ Traditional technology ✧ Non-sustainable

Barriers and Challenges for Informal Sector Integration In E-waste Recycling

Economic	Imports & Commodity Prices
	Stable Supply & demand
	Established Business Model
	Access of Financing Resources
Regulatory	Definitions & Criteria
	Hazardous Materials
	Cross-Border Transportation
	Zoning and Land Use Regulations
Data and Technical	Information Access
	Quality Control
	Waste Stream Contamination
	Skill Upgradation
	Technology Advancement
Social	Consumer Perception
	Good & Sustainable Work
	Establishing Trust

Source: 1. WBCSD, Informal approaches towards a circular economy, 2016; 2. Adapted by the author.

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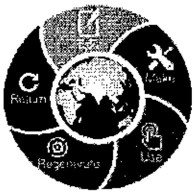
III. Circular Economy and E-waste Recycling

- ☐ Circular economy is a regenerative economic system
- ☐ Transition from take-make-dispose models to take-make-use-regenerate resource model
- ☐ A new model for sustainable development and green economies
- ☐ Aims to redesign the production and consumption systems
- ☐ Emphasis on social, environmental, economic and cultural aspects



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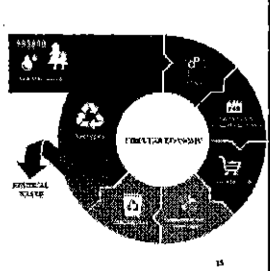
Benefit of Adopting CE Model In E-Waste Recycling

- ☐ Reducing pressure on the environment
- ☐ Improving the security of the supply of raw materials
- ☐ Increasing competitiveness
- ☐ Stimulating innovation
- ☐ Boosting economic growth
- ☐ Creating jobs



15

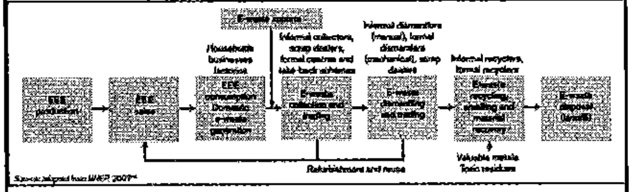
IV. Informal Sector Integration in the E-Waste Recycle System

Hostile Stances	Disconnected Management Approach
★ Unfair market competitors under EPR policies ★ Implement importation ban to restrict flow of incoming e-waste ★ Strict government intervention by fines and imprisonment	★ EPR management scheme lay burden to producers to be responsible for collection and treatment of the end-of-life products, but fail to recognize the existence and capacity of informal e-waste recycling system.
Limited or Non-cooperative Interaction	**Synergetic Approach**
★ Acknowledges the significance of informal recyclers and actively interact with them, but in a loose and ineffectual manners.	★ A deeper form of partnership between the informal and the formal recycling sectors, makes the most of the strengths of each sector, and operates across as much of the value chain as possible.

Informal Sector

16

Simplified life cycle of electronic and electrical equipment



17

V. Positive Contribution of Informal E-Waste Recycling Sector

- Gives the opportunities for e-waste recycling workers to generate a relatively good income and provide for their families.
- Informal e-waste recycling sector adds value to the economy by transforming waste into tradable goods.
- E-waste recycling avoids incineration, which causes hazardous emissions.
- Pushes the transition towards circular economy and encourages technological innovation for recycling.
- Waste disposed on rivers and lakes coasts pollute water. Managing waste contributes to making water less polluted.
- Public savings: reduce costs associated with waste management for municipalities (waste collection, disposal,...)

V. Positive Contribution of Informal E-Waste Recycling Sector

- Very high recycling rate achieved
- Recycled e-waste decreases the need for virgin material
- Enables CO2 savings by avoiding carbon emissions related to the production of virgin materials and reducing the need for incineration.
- Decreased quantity of waste ending up in the ocean: contributes to mitigate ocean's pollution.

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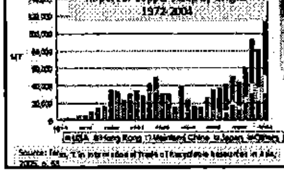
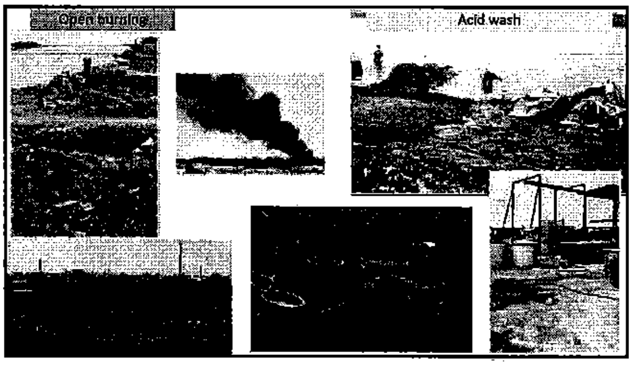
VI. E-waste Recycling Activities – The Taiwan Model

- Due to the rapid growth of industrialization and economic growth and lack of natural resources, Taiwan started to import vast amount of resources, including mix scrap metals in 1970s and hence developed the scrap-metal industry.
- Numerous electronic waste recovery industries used open burning and acid washing to recover metals from waste electrical circuit boards and cables along the Erjen riverside.





E-waste Activities in Taiwan in 1970s to mid-1990s

- The 1986 green oyster incident in the river estuary forced the TEPA and local government to initiate several restoration measures to remediate the river.
- Oyster cultivation has been forbidden at the estuary in 1986.
- Special zone for resources regeneration was established in Da-Fa County and Wan-li County to relocate illegal smelting plants to this area in 1983, however, very few enterprises are willing to move in, so this measure has been deemed as unsuccessful. In 1992, Da-Fa Industrial park was closed due to the fire.
- In 1993, the government has banned the import of waste-metals for the scrap-metal industry, and commenced a program for the restoration of the river.
- By 2001, all of illegal scrap-metal factories along the riverbank were demolished. The source of metal pollution of the river was thereby significantly decreased.

Institutional Reform for Recycling in Taiwan

- In 1997, the Waste Disposal Act (WDA) was amended to introduce the Producer's Responsibility Principle, stipulates that the manufacturers, importers and sellers of articles, packaging, or containers shall be responsible for the collection, clearing away and disposal thereof if such waste:
  - is not easily cleared away or disposed of;
  - contains components that are not readily biodegradable;
  - contains hazardous substances; or
  - possesses recycling or reuse value.

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Institutional Reform for Recycling in Taiwan

Date	Milestone
1997/7	Establishment of Resource Recycling Management Fund (RRMF) and Recycling Fund Management Board (RFMB)
1998/3	Home appliance was promulgated as mandatory recyclable waste.
1998/6	Subsidize the waste appliance storage site (44 company with 67 sites)
1998/6	Subsidize waste IT equipment collection site
1998/11	Retailers of home appliances are responsible of taking back end-of-life electrical appliances without charge.
2002	EPA promulgated standards for the methods and facilities for the collection, storage and recycling of waste appliances and waste IT equipment.
2007	Electrical fans and keyboards were listed as mandatory recyclable waste by EPA.

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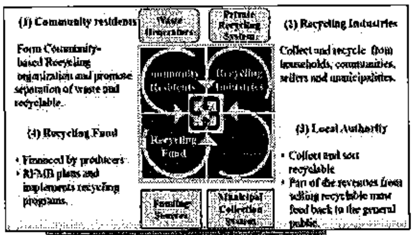
Institutional reform for Recycling in Taiwan

- Along with the amendment, the underlying institutional framework was reformed according in 1997.
- This reform can be viewed as the first move of the EPAT to integrate informal sectors with formal sectors.



Policy Innovations and Implementations

- **Recycling Fund plays a core role** by providing financial resource to the recyclers to help establishing the e-waste treatment infrastructure needed.
- **Three integration modes can be observed after the 4 in 1 system:**
  1. The integration of upstream producer with downstream recyclers.
     - Motivated by potential profit.
     - To reclaim the upstream recycling fee paid from the recycling subsidies.
     - A reverse logistic channel is established to realize the producer responsibility.
  2. The integration of recyclers with collectors.
     - To ensure a stable and sufficient supply of e-waste collected for recycling.
  3. The integration of informal collectors with formal collectors.
     - Induced by each actor's competitive advantages that relative high labor intensive works tend to be operated by informal sectors.

Other coordinated set of measures of integrate informal sectors in e-waste recycling system

- To strengthen the enforcement of **municipal zoning ordinance** by the local authority to prevent illegal land use of collection, storage and recycling of e-waste.
- To help solving the problem of acquiring appropriate site for e-waste storage and treatment, the TEPA is authorized by WDA to establish special recycling Demonstration zone, in which operational, financial and legal assistance is provided to enterprises in this zone
- To enhance auditing mechanism to ensure the final residual wastes to be properly handled by licensed organization so that both the amount and final disposal site can be traced.
- To set up ***Technical Advisory Committee*** to provide technical assistance as well as annual performance evaluation, the result can be served as a basis for the design of differential subsidies for the recyclers to encourage and assist the enterprises to upgrade their technological level.

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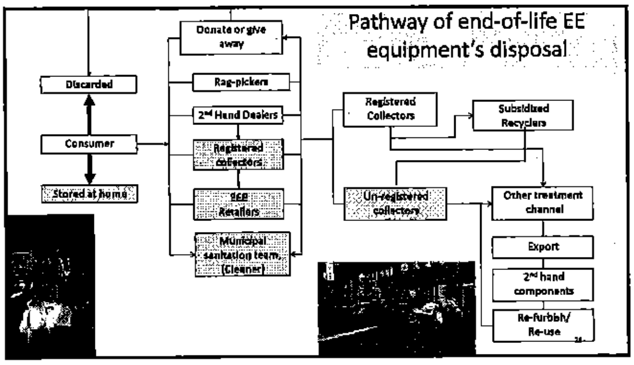
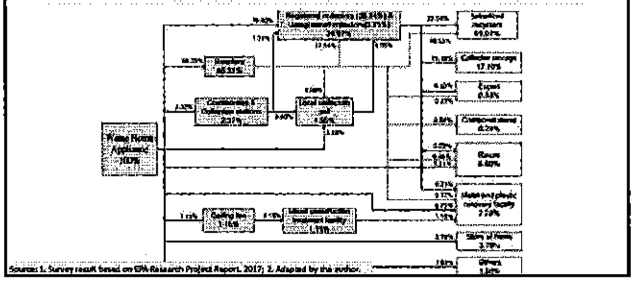
Pathway of end-of-life EE equipment's disposal

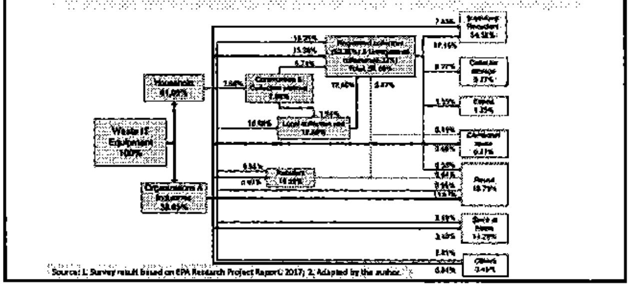


Consumer Behavior on Disposing An End-of-Life Home Appliance— 2016 Survey Result



Source: 1. Survey result based on EPA Research Project Report, 2017; 2. Adapted by the author.

Consumer Behavior on Disposing An End-of-Life IT Equipment— 2016 Survey Result



Source: 1. Survey result based on EPA Research Project Report, 2017; 2. Adapted by the author.

Sustainable Resource Utilization via Circular Economy

- **2018-2020 Resource Recycling and Reuse Plans**

  To build a circular economy and achieve sustainability, including maximizing resource utilization and minimizing the impacts on the environment.

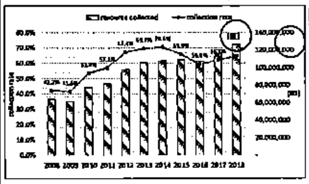
- To promotes strategies based on life cycle assessment of various materials, which covers production, consumption, waste management, and reused material markets. A cross-departmental action strategies, measures, and key performance indexes are formulated to handle e-waste and other waste which would generate serious impact on environment.

- **Perfecting management of recycling and treatment channels**

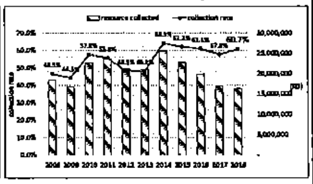
  The EPAT has actively encouraged authorities in charge to conduct recycling plans, open up recycling channels, and increase recycling results.
- To recruit recyclers from informal sector, the Circular Economy and Recycling Army Plan prescribes the hiring of 2,982 people every month in average in 2019 to help sort recycled wastes.
- To prevent self-employed recyclers from being financially affected by price changes in the recycling market, the Recycling Care Program, newly launched in 2019, focuses on self-employed recyclers that are also medium-low income households. Subsidies of NT$5/kg or NT$20/set (or unit) are provided for EOL products.

Indicators for collection and recycling performance

Collection rate for home appliances



Collection rate for IT products



Source: Statistical data provided by RFMB, EPAT; 2. This study

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VII. Concluding Remarks

- Taiwan's e-waste recycling system is established based on EPR principle, and its past successful experience In dealing with informal sectors can be attribute to the following factors:
  - Recognition of the vital role of informal sectors and pursuit of an inclusive governance in recycling system reform to exert market mechanism, which derives a profit motivated division of labor between formal and informal sectors.
  - Adoption of an adaptive regulatory framework and an effective compliance and enforcement mechanisms to ensure a well-functioned e-waste recycling system.
  - Facilitation of the operation of market mechanism with strong administrative supervision that induces a diversified patterns of market integration, which eventually achieve a cost-effective operation of the recycling system.
  - Assistance for the collectors and recyclers to solve the finance, technology and land use problems in order to build up a stable and viable recycling environment for the enterprise.

Thank you !

stєp

E-Waste & Jobs

December 2-4, 2019 | IEMN BANGKOK

Presentation Structure

- Project Motivation
- Background
- Proposed Methods
- Worked Methods Example - Ireland
- Moving Forward

Motivation

- Understand how many jobs would be created if e-waste was treated under "formal" conditions
- How would different approaches change the number of people working?

Background

- Literature Review
  - Large focus on health and safety in informal sector
  - Very little data on # of jobs/workers
    - some workforce data outdated or in the wrong category
    - existing data on #s working in developing nations often not backed up and may be missing #s of women and minors

Sample Country Profile

step

Country / Economy	Region	Population (1000)	E-waste generated in 2016 (kg/inh)	E-waste generated in 2016 (kt)	National regulation in force in January 2017
Ghana	Africa	27573	1.4	39	no

- E-Waste scavenging employs 4500-6000 in Accra directly, and approximately 30,000 within broader e-waste economy (Agyekum, 2010)
  - However: Huge range. Where did these numbers come from? Who do they include?
- Agbogbloshie treats over 171,000 tons of e-waste annually (Prakash et al., 2010)

Sample Country Profile

step

Country / Economy	Region	Population (1000)	E-waste generated in 2016 (kg/inh)	E-waste generated in 2016 (kt)	National regulation in force in January 2017
China	Asia	1378984	5.2	7211	yes

- Guiyu treats over 20 million tons of e-waste annually (Chi et al., 2011)
- ~100,000 people work as e-waste recyclers at Guiyu (Heacock et al., 2015)
  - Again: Who is and isn't included? How were they counted?

Background

step

- Limited literature foundation
- Different treatment practices occur in different places
  - Develop a model with potential to be adaptable and to capture the complexity of different scenarios
- Working with what we have...
  - There is no current model for estimating e-waste jobs
  - Goal: create a model to be the foundation with which these numbers can be estimated in an evidential way

Proposed Methods

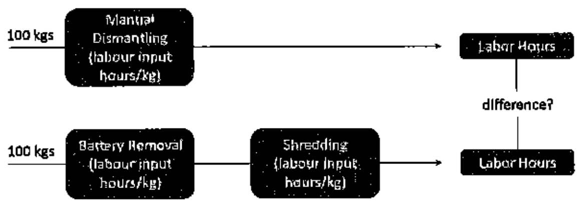
step

- Working with what we have...

Motivation

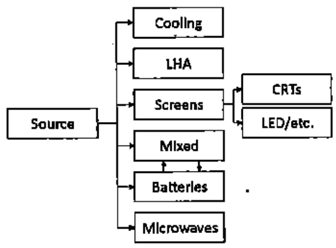
stēp

- Goal: Understand labor implications of e-waste policy/practice changes.



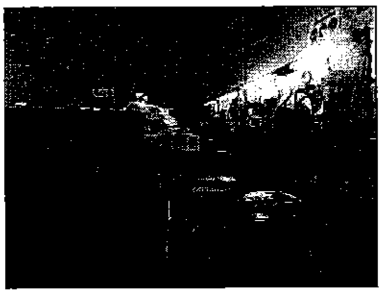
Field Trial- Ireland

- Selection
- 3 Day Observations

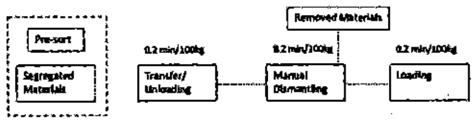


Microwaves

- Tools: hammer, screwdriver, ergonomic work desk, fork lift



Microwaves



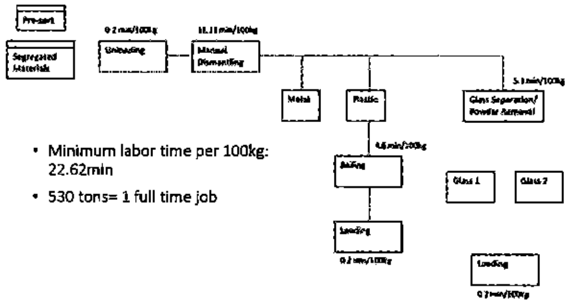
- Minimum labor time per 100kg = 8.6 min
- 1395 tons = 1 full time job

averages

CRTs

- Tools: hammer, screwdriver, ergonomic work desk, forklift, compactor, powder vacuum

CRTs

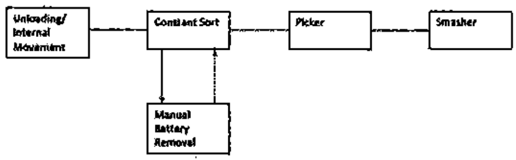


- Minimum labor time per 100kg: 22.62min
- 530 tons= 1 full time job

Mixed Stream

- Room 1: pickers manually separate pieces unsuitable for the machines
- Room 2 (pictured): pickers continue separation along conveyer as it moves through the "smasher" and subsequent shredders

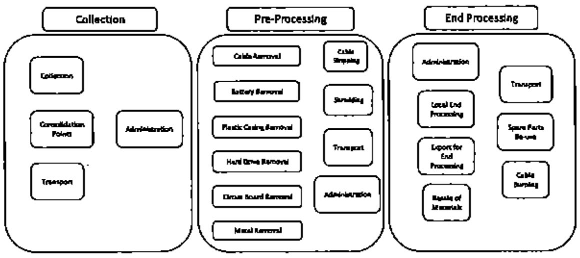
Mixed Stream



- 25-30 tons per day
- Belt running 8 hours
- ~ 15 employees at any given time
- ~ 417- 500 tons = 1 full time job

Proposed Methods

- (ex) Potential computer flow map



Moving Forward

- Data collection
  - Collect data in order to build, modify, and illustrate the functioning model.
    - Completed for Ireland
- Additional field trials
  - Collect more representative on the ground data
    - Varied locations

Thank you for your attention

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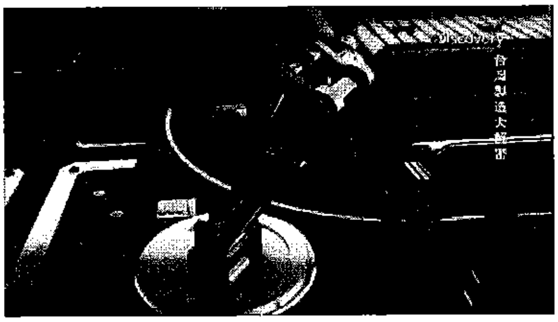
Solving the E-Waste Problem Initiative
www.step-initiative.org
info@step-initiative.org

Technical Inspiration of Waste Treatment

- **Introduction for GGE company (Video)**
- **Overview of the GGE's ECO Economy**
- **Innovative ways to turn waste into resources**
- **Value creation for byproducts**
- **Q&A**

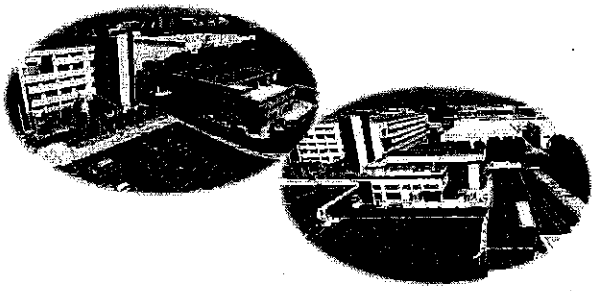
Introduction of GGE company



Introduction of GGE company

Liuying Plant – Circular Economy Demonstration

Operating as of July 2019, Liuying Plant in Tainan is the 1st integrated treatment centre in Taiwan that demonstrates a well-functioning circular economy where high-tech industrial residues and scraps are recovered and recycled into high valued products.



Innovative ways to turn Waste into Resources

I. Recyclable Materials of High Quality

- Recycling >Turn Scraps to Valuables

II. Recyclable Materials of Low Quality

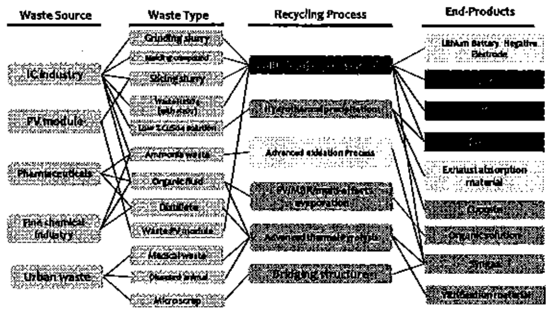
- Recovery > Reform Waste to Resources

III. Non-Recyclable Materials

- Plasma Processing > ECO Friendly Treatment

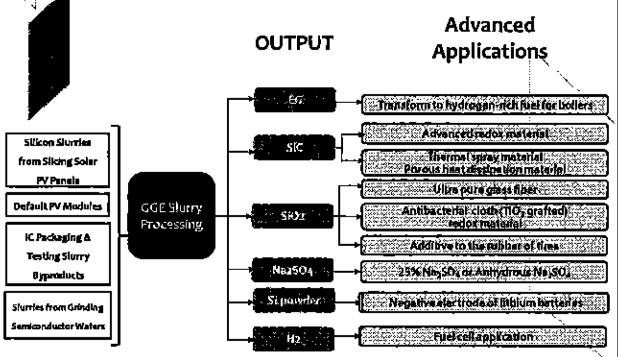
REDUCE • REUSE • RECYCLE

Overview of the GGE's ECO Economy



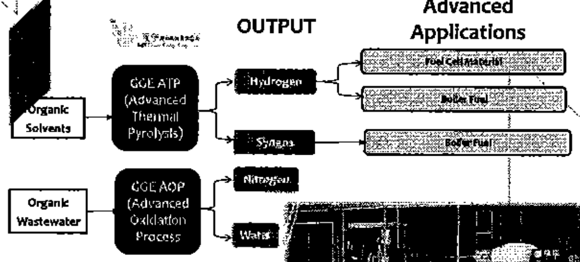
I. Recycling Industrial Residues of Hgh Quality into Valuables

《Integrated Treatment Centre: Liuyin Plant in Tainan Taiwan》

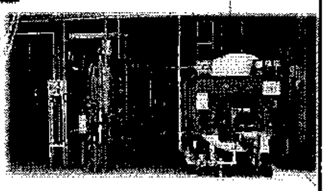


II. Recover Industrial Residues of Low Quality into Resources

《Fab within Fab: In-House Treatment》

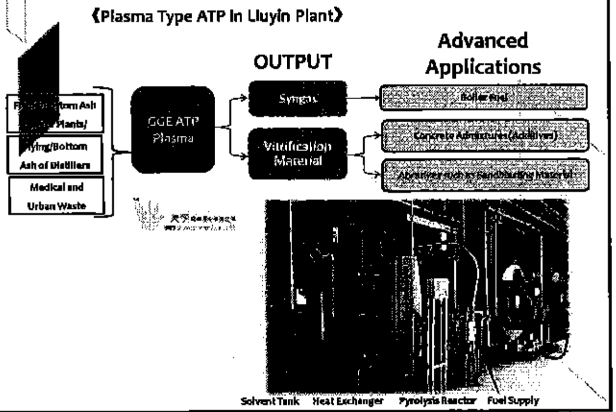


- Monthly Capacity：60 tons
- Target：High water-contained organic solvent
- Syngas can directly replace 30% LNG fuel of boiler
- Potential Clients: UMC, ASE/SPIL, TSMC, etc.

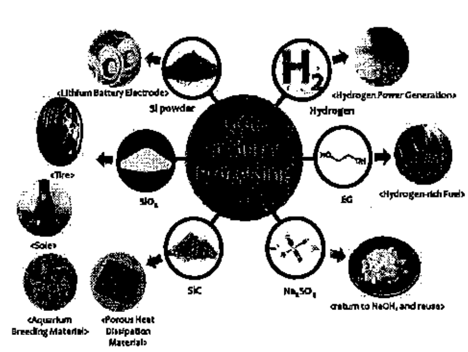


III. Plasma Processing: Eco-Friendly Treatment of Nonrecyclables

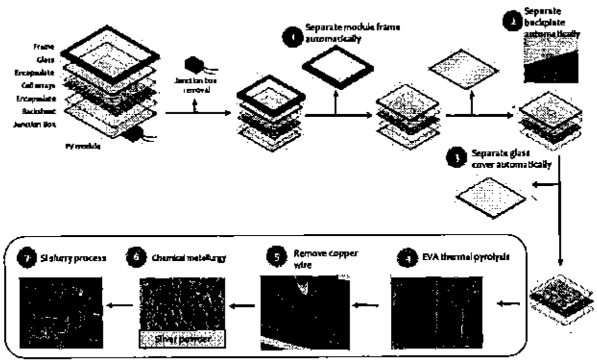
《Plasma Type ATP in Liuyin Plant》



Value creation for byproducts



Value creation for the waste of Solar Photovoltaic Industry



Apendix:Patent List

item	Description
1	Silicon-contained composite particles for the negative electrode stress buffer of lithium ion battery and manufacturing method (Patent : I550942)
2	Negative electrode composition of lithium ion battery (Patent : I549339)
3	Preparation of negative electrode composition of lithium ion battery (Patent: I549337)
4	Silicon-contained composite material of applicable for negative electrode of lithium ion battery and the negative electrode composition (Patent: I570181)
5	Material of electrode of lithium ion battery and manufacturing method, and the electrode materials that suitable for lithium ion battery (Patent: I539649)
6	Hydrogen-producing composition and manufacturing method thereof (Patent: I570059)
7	Application of Si slurry and its products (Patent: I686872)
8	Conductive fiber with carbon nanotube(Patent : I617657)
9	Silicon particle polymer covalently bonded mixture and its anode material(Patent: I620713)
10	Nitrogen doped carbon-silicon composite material and manufacturing method thereof(Patent: I646051)

Q & A

Thank You!

Company Disclaimer

WASTEFORCE Project

About WasteForce

- December 2018 – December 2020
- Funded by the Internal Security Fund - Police
- IMPEL leading beneficiary
- United Nations University (UNU) co-lead

Associated Beneficiaries:
- *Slovenia (IRSOP)*
- *Portugal (IGAMAOT)*
- *Germany (Police University)*
- *Ireland (Limerick University)*
- *Netherlands (Dutch Forensics Institute)*
- *United Nations Institute for Training and Research (UNITAR)*

funded by the European Union's Internal Security Fund – Police

Aims

To boost the operational activities and capacities of authorities involved in the fight against illegal trade and management of waste through:

- (i) development of new practical tools and methodologies (WP2, WP3);
- (ii) implementation of multi-stakeholder capacity building activities (WP5); and
- (iii) support of operational networking among practitioners in Europe and in the Asia- Pacific region (WP4).

Output

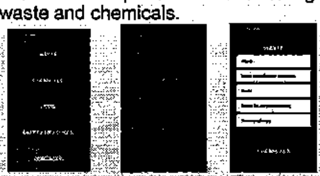
- Better insight in trends and developments in the waste market
- Impact analysis method for waste policy changes
- Improved prosecution
- Better skilled law enforcement authorities

Progress – Waste Crime Alerts

- 3 Waste Crime Alerts published (link)
- provide authorities and law enforcement quarterly overview of developments in the illicit waste trade *(for example to certain geographic locations/routes and the identification of modus operandi for specific waste flows)*
- Open source information: news cases, enforcement agency bulletins, outcomes of court cases, relevant publications and policy updates.

Progress – Watch-IT App

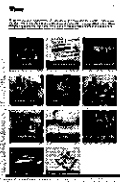
Waste and Chemicals Inspection Tool » to support inspectors and law enforcement officers responsible for monitoring transboundary shipments of waste and chemicals.



Progress – Watch-IT App

Progress – Capacity Building

- Online tools:
  - Research Library
  - Capacity Building toolkit (launched October)
  - Clearing House Mechanism (launched October)
  - Webinars



Waste Force

Progress – Capacity Building

- Trainings:
  1. Portugal 27-29 November on Prosecution of Waste Crime (IGAMAOT)
  2. Germany March 2020 (Policy University)
  3. Slovenia May 2020 (Environmental Inspectorate)
  4. Thailand June 2020 (UNEP-AP)

Waste Force

Progress - Methodologies

- **Measure the Impact of environmental damage:**
  - Collect existing technical methods used to estimate damage and the number of criminal cases they relate to
  - Generate information on environmental damage caused by waste crime
  - Support prosecutors in criminal cases

Waste Force

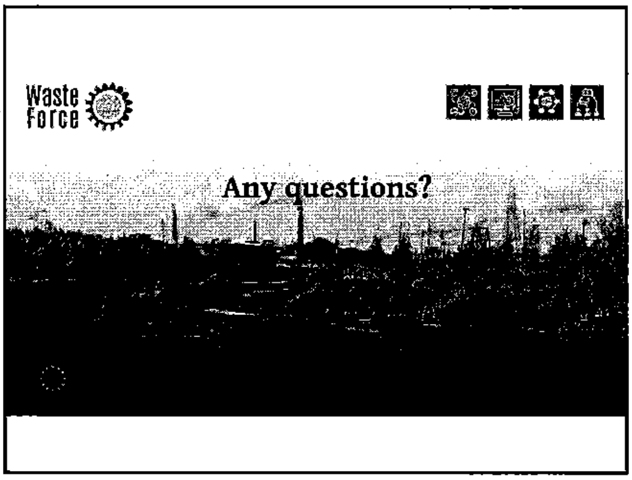
Progress - Methodologies

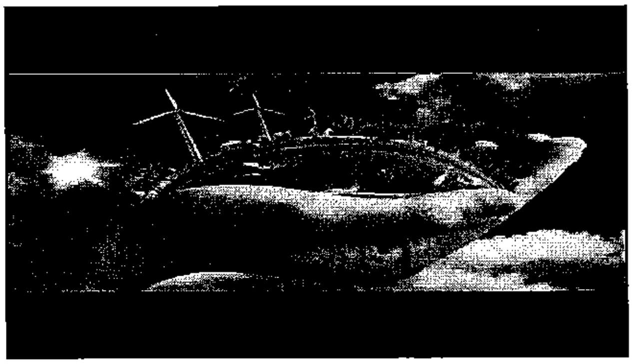
- **EU and Global Policy Impact Analysis Methodology:**
  - to analyse existing impact assessment methodologies for policy changes linked to waste trade and management
  - to propose improved and integrated models to predict the impacts of future policy changes

Waste Force

Progress – EU-Asian Cooperation

- Inventory of information exhange mechanism between EU and Asian Pacific countries
- Guidance for prosecutors (consultations in Asia and the EU coming up)


Waste Force
Any questions?



1. Introduction

- Electronics industries in Taiwan
- Problems in electronics industries

2. Technical cycles applied to the electronics manufacturing waste and post consumer e-waste

- Concepts of the circular economy for electronics industries
- The cooperation case of electronics industries in Taiwan
- The cases of recycling wastes in electronics
- Post consumer e-waste

3. Summary

- Close remarks
- Prospects in future

At present, Taiwan's electronics industry mainly focuses on the following three major developments: electronic component products, IC industry and information hardware industry. The main distribution areas are in the three science parks in Taiwan.

- Electronic component products: integrated circuit, LCD panel, light-emitting diode, printed circuit board, etc.
- IC industry: IC design, IC OEM, IC packaging, etc.
- Information hardware industry: computers, motherboards, etc

As Taiwan's most famous electronics industry - semiconductor industry for reference:

In 2017, the output value was NT$ 2.46 trillion, which accounted for 15% of Taiwan's GDP and was the backbone of Taiwan's economy.

Taiwan's semiconductor industry ranks in the world:

Taiwan's total IC output value is the third in the world

Taiwan's IC design output value is the world's second

Taiwan's foundry output value is the world's first

Taiwan's IC packaging and testing foundry value of the world's first

Taiwan's electronics industries have experienced a flourishing development. However, even if the electronics industries continue to improve now, there is still much room for improvement of the circular economy. For example, a various and great amount of wastes, pollution and industrial cluster are the main problems of electronics industries in Taiwan.



1. Wastes: The amount and the kinds of wastes of electronics industries which throw away every day are great and various. The concepts of the circular economy tend to reduce the generation of wastes and reuse them for reducing waste emissions. However, due to the large amount and kinds of wastes generated by the electronics industries, it is difficult to have enough downstream industries to cope with them. Due to this situation, it results in the wastes still can't be properly recycled and reused.

2. Pollution: As the electronics industries may add acid, alkali, organic solvent or metal powder in the process of producing the product, some of the wastes will have pollution as well. For example, calcium fluoride sludge produced by the semiconductor industry will have fluorine pollution. Nowadays, most wastes do not have a complete inspection system. Therefore, to prevent pollution from entering the downstream manufacturers' systems, most companies directly refuse to reuse the waste.

3. Industry clustering: Most of the electronics industries today are clustered in the form of science parks, so the total amount of waste generated is quite large. However, there is no way to immediately transport waste to the downstream manufacturers (because most downstream manufacturers are not located inside the parks). In addition to the increase cost of shipping, there are also environmental pollution caused by waste during transportation.

1. Wastes: From the perspective of the circular economy, upstream companies should have the classification of the wastes first. After that, notify downstream companies and make them know how many wastes they can reuse and recycle. In addition to knowing which kind of waste will be used in large quantities, such a method can also avoid the situation that the downstream manufacturers are overburdened. In Taiwan, the Environmental Protection Administration (EPA) announces the flow direction of wastes and how many wastes are used every month. On account of this system, upstream industries can know which companies are able to recycle the wastes and downstream industries can adjust the acceptance to meet their needs.

2. Pollution: The polluted wastes still can be recycled or reused in other industries as well. However, it needs strict inspections for every waste to make sure that they aren't beyond the standard. Downstream factories can establish rules of wastes and ask upstream factories to measure the compositions first. When the wastes are sent to downstream factories, they will also verify the components. If the wastes do not reach the standard, downstream factories can send them back and request upstream factories to do pretreatment again.

3. Industrial cluster: The advantages of industry clustering are enough manpower, low price of energy usage and improvement of technology. However, the electronics factories congregate together will make a great number of wastes and hard to deliver. Due to this situation, downstream industries try to combine with electronics industries to get the resources they need.
The advantages of this new mode of industrial clustering are less transportation distance and fee, less pollution and more usage of wastes. It would be more natural for the arterial industry to include the venous unit. In Germany and Japan, industries are progressing in such a manner.

In Taiwan, the cement industry is highly dependent on raw materials. The main material is limestone, silica, alumina and iron oxide. However, the progress of getting resources makes the hazards to the environment. Due to this situation, cement industry tries to use the wastes of electronics industries to be alternative materials and fuels. For example, calcium fluoride sludge, silicon sludge and waste solvents are the wastes of the semiconductor industry.

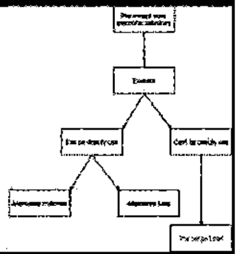
Alternative materials	The code of wastes	The using situation
Calcium fluoride sludge	R-0910	2765 tons/month
Coal ash	R-1106	367635tons/month
Bottom ash	R-1107	84126tons/month
Waste glass	R-0401	12315 tons/month
Waste foundry sand	R-1201	14071 tons/month

Alternative fuels	Items
Aqueous fuel	Tar, Distillation residue, Waste solvent, Waste oil
Solid fuel	Paper, Waste rubber, Waste tires, Plastic, wood, garbage, sewage sludge
Gaseous fuel	Landfill gas, pyrolytic gas

In order to use the wastes, cement industry set up a standard for wastes to protect the cement kiln and make sure the quality of cement. Cement industry not only wants to protect the cement kiln and produce a high quality of cement but also wants to have more alternative materials and fuels to reuse from electronics industries. On account of this situation, the cooperation mode between the cement industry and electronics industries can be divided into three parts.

Elements	Limit
Mg	6%
Na	0.7%
K	0.7%
Cl	1.5%
S	5%
F	1%

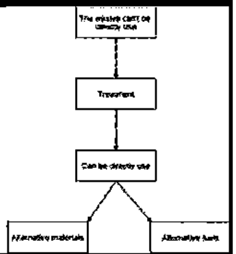
First part is checking the wastes which are received from electronics industries. The cement industry will measure the components of wastes first. If the contents of components are beyond the standards, cement companies will ask upstream factories to do other treatments. On the other hand, the wastes which are less than the value of standards, they will be classified and decided to be alternative materials or fuels.



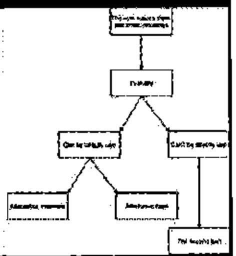
The wastes which are beyond the value of standards will have treatments in the second part. Sorting, changing the proportion, purification are the main methods to reduce the impurities. Gravity separation, magnetic separation, eddy current separation and screen can efficiently remove the impurities which are harmful to the progress.

Methods	Function
Gravity separation	Separate the different gravities of substances
Magnetic separation	Remove the excessive Fe, Co, Ni and Mn
Eddy current separation	Separate the Al
Screen	Separate the different sizes of substances

Changing the proportion is the easiest way to cut down the number of impurities. The wastes which do not pass the inspection will be added to the lower concentration of wastes. On the other hand, if the impurities are hard to be removed, solvent extraction or ion-exchange will be used as well. However, these methods can't be used to treat a great number of wastes. Hence, they're seldom used in this process.



After the first and second part, finding new wastes which can be reused for the cement industry is a significant mission as well. However, the components of many substances are complicated and difficult to remove the impurities. Hence, this step should combine with the first and second step. The new wastes are needed to measure the components and properties first when they come from the electronics industries. If they pass the standard, they can be reused directly. On the contrary, the wastes should have treatment when they are beyond the value of standards.




Silicon sludge


Solar panels

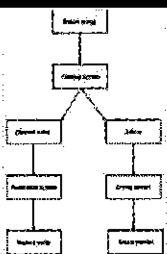

Waste solvents


Waste phosphoric acid

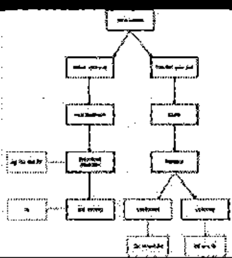

Gallium nitride


Gallium arsenide

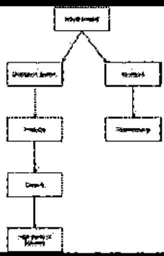
Silicon sludge mainly comes from backside polishing slurry of the semiconductor industry. Using the filtering system can make silicon and water separated. After that, the drying system will evaporate the extra water of silicon and produce silicon powder. On the other hand, pure water purification system can make water resources be reused to reach the goal of zero-emission.



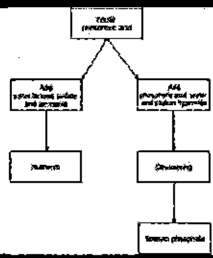
The waste solar panels can be divided into silicon solar cell and thin-film solar cell according to the different structure. Silicon solar cell will get silver, bronze, lead and silicon by heat treatment, electrolytic extraction and wet etching. On the other hand, waste thin-film solar cell can get bronze, indium, gallium, cadmium and tellurium by crushing, flotation, electrolysis and leaching.



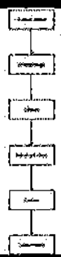
The waste solvents and waste phosphoric acid are common substances from electronics industries. Because they all reacted with many raw materials such as wafers, solar panels or circuit board, they may have many impurities and are hard to reuse. Waste solvent will be sent to the distillation system and get the residue and high purity of the solvent. The advantages of this progress are reducing the cost and efficiently separating the various kinds of solvents.



The waste phosphoric acid has two methods to reuse which are according to its purity. Water, ferrous sulfate and ammonia are added into low purity of waste phosphoric acid to produce the nutrients for plants. On the other hand, high purity of waste phosphoric acid can combine with phosphoric acid, water and sodium hydroxide to precipitate sodium phosphate which can be reused in other industries.



Gallium nitride and gallium arsenide mainly come from the semiconductor industry. Ion exchange can separate the gallium efficiently from gallium nitride. The adsorption rate can reach 98% and the desorption rate can reach 80% which the hydrochloric acid is used as desorbent. With this method, the high purity of gallium-ion solutions can be gotten. The high purity of gallium solutions can be adjusted the pH value at 4 and calcined at 900°C for 4 hours to get gallium oxide.



Solvent extraction can be used to recover gallium from gallium arsenide. Using extractant to extract and sulfuric acid to strip can get a high purity of gallium-ion solutions as well. The high purity of gallium solutions can be adjusted the pH value at 4 and calcined at 900°C for 4 hours to get gallium oxide.

Reuse of consumer system

1.Reuse directly
Example: Beer bottles, glass door and used cars

2.Downgraded reuse
Example: Waste lithium-ion batteries of electronic cars can be reused in small machines

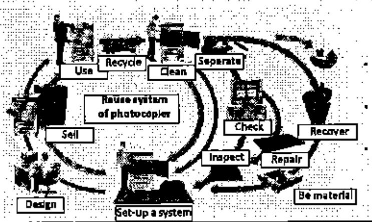
3. Regenerated reuse
Example: photocopier and camera

4. Resources circulation
Example: Recover the valuable metals from waste machines such as Television, refrigerator, washing machine and air conditioner

Reuse of consumer system-Photocopier (1)

Fuji Xerox became the first in the industry to succeed in recycling plastics. They created a material reusing system where the exterior covers (ABS plastic) of the copy machines recovered from the market are separated, crushed, and cleaned, and used as raw material for creating recycled plastic of the same quality as newly made ABS plastic. This recycled plastic is then used in manufacturing products. Today, recycled plastic is used in the production of copy machines for parts in the exterior cover, which is where the strictest requirements apply in the appearance quality of recycled plastic.

Reuse of consumer system-Photocopier (2)



- The ownership of photocopier is company. Consumer just rent the photocopier.
- The missions of recycling, cleaning, checking and repairing belong to company.
- This system can save money, resources and make materials be reused.

Reuse of consumer system-Camera

Digital cameras, like all electronics, are produced using valuable materials. Its microchips contain gold and platinum, copper in the wiring and aluminium elsewhere. Digital cameras are also often equipped with nickel-cadmium and lithium-ion rechargeable batteries that both contain elements that can damage humans if consumed in a sufficiently large amount. In solder inside the camera, the lead, a heavy metal, is found. None of these elements can be disposed in a site or incinerator where water, soil and air are present. Rather, like other products they should be re-used. Make sure that your digital camera is recycled when it comes the time to dispose it.

Reuse of consumer system-Camera

The camera parts are shredded and first segregated to metals and plastics. The plastics are treated separately and metal parts are treated in a different way. Different metals including the metals of Batteries are collected using a specific process. Once the plastics and metals are separated, they are sent to different collection points, from where they are distributed to be reused. Highly sophisticated machines are used for the segregation and shredding process.

Reuse of consumer system-Computer

Electronic waste is so much about the computers. Unlike other gadgets, computer is a corporate necessity and hence the flow of computer trash is much more than any other item. The best thing we can do to utilize the item to the fullest is its recycling. This way, we will be able to use all the good parts, extract the precious elements and minimizing the landfills. There are many precious and none precious metals such as bronze, silver and tin which are in the hardware of the computer. They will be crushed, seperated and then used as a metal in automobile or similar industries.

On the other hands, sometimes we will fix the computer and make them be able to downgraded reuse. For example, the computers of government will be used for 5 years and then sent to partial schools.

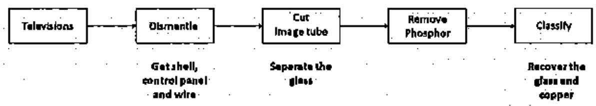
Reuse of consumer system-Television

All heavy equipments, we plug into power sources are included in large electronics. The large electronics category includes big screen TVs, copy / printers and audio receiver. It is important to have recycling for these equipments because of the fact that they contain many of wires and electronic components, which are highly valued in the recycling market. Large equipments like TV can be recycled to add extra value to it. In this process, the important parts of the Television sets are recycled so that their value can be enhanced.

Recyclables Depot		A	B	D	E	F	Total
Television	Amount	80,387	173,374	124,053	154,350	72,631	604,795
	Weight(T)	1,830,996	3,683,764	3,181,951	4,082,823	1,785,095	14,566,629

The recycle amount of television in Taiwan (per year)

Reuse of consumer system-Television



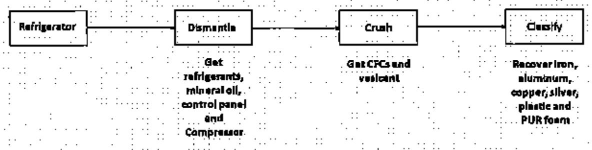
Reuse of consumer system-Refrigerator

Refrigerators and freezers contain refrigerants, oils, and other compounds which must be removed and recovered. Then the steel, copper, silver, other metals, and selected parts can be recycled. Some recycling programs also capture the foam insulation inside the refrigerator doors for added environmental benefits. The average refrigerator aged 10 years or older contains more then 120 pounds of recyclable steel and other materials.

Recyclables Depot		A	B	D	E	F	Total
Refrigerator	Amount	54,652	109,439	40,243	79,634	37,323	321,293
	Weight(T)	2,870,676	3,874,602	3,228,278	5,135,672	2,561,374	18,670,802

The recycle amount of refrigerator in Taiwan (per year)

Reuse of consumer system-Refrigerator



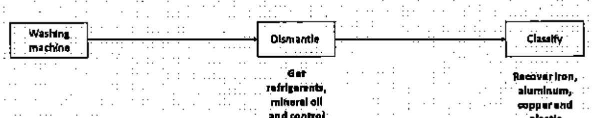
Reuse of consumer system-Washing machine

Washing machines are made almost entirely of metal and plastic. The body is made with steel. So is the drum or wash tub (where the clothes are held), although it may be coated with porcelain to prevent it from rusting. The buttons and dials on many washing machines are made with plastic, as are some interior components. The washing machine cord is made of copper coated with plastic. Washing machines contain small motors that turn the drum during the different wash and spin cycles. Those motors contain a small amount of iron, copper and aluminum. Otherwise, a washing machine contains no toxic components.

Recyclables Depot		A	B	D	E	F	Total
Washing machine	Amount	65,678	174,750	48,302	92,883	36,638	418,433
	Weight(T)	2,364,890	4,635,423	1,873,963	3,925,167	1,434,586	14,256,029

The recycle amount of washing machine in Taiwan (per year)

Reuse of consumer system-Washing machine



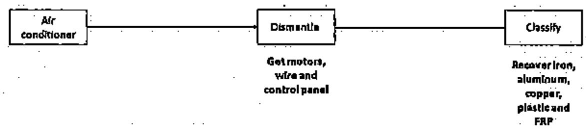
Reuse of consumer system-Air conditioner

Air conditioner contains refrigerants, oils, iron, copper and aluminum which must be removed and recovered. The refrigerants and oils can be gotten in the separated process. Iron, copper and aluminum can be directly downgraded reused or recover through other chemical methods.

Recyclables Depot		A	B	D	E	F	Total
Air conditioner	Amount	65,678	174,730	48,302	92,885	36,638	418,433
	Weight(T)	2,364,890	4,655,423	1,875,963	3,925,167	1,434,586	14,256,029

The recycle amount of air conditioner in Taiwan (per year)

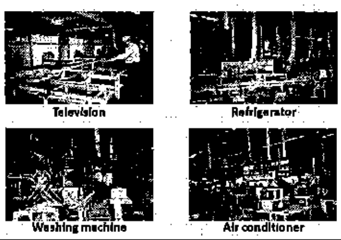
Reuse of consumer system-Air conditioner



Reuse of consumer system-Phone

At the end of their lives, telephones or mobile phones can be recycled. Rapid changes in technology, low initial costs and anticipated obsolescence have led to rapidly growing surpluses which contribute to a growing number of electronic wastes worldwide.

In many cases, companies in other parts of the world, often in developed countries, will try to reuse the old mobile phone. This makes sure the phones do not end up in the trash immediately if they remain unusable. Batteries are taken out and sent for recycling. The telephone is then crushed and heated to approximately 1100C. Samples are then converted into small pieces and further chemical processing is carried out before they are transferred to a smelter that takes the corresponding metals for use. Energy-from-incineration is used to recover plastics from phone components. The outer body plastic of the telephones is generally grained and reworked and used in mouldings.



- Establishing the new mode of electronics industries, reducing the e-wastes and reusing the resources can protect the environment which we live
- Electronics industries of Taiwan is also responsible for environmental protection and resources recycling. However, today's technologies and thoughts are still not comprehensive
- It is necessary to have new ideas to cope with the problems which we will meet
- Low-energy and low-cost combine with pollution free and zero waste will be reached in the future

ECO

THAMMASAT
people & sustainability

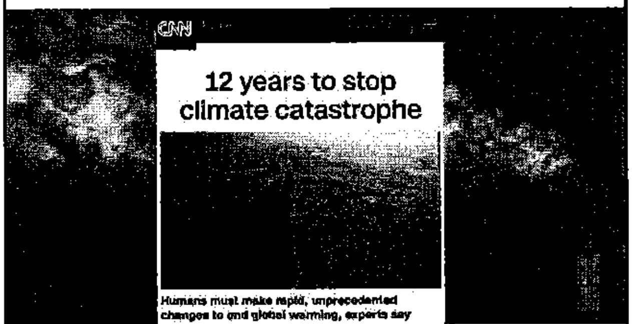
Public Private Partnership
For SDG 12 and SDG 17

2019 International E-Waste Management Network Workshop
December 3, 2019

Prinya Thaewanarumitkul, Ph.D
Vice Rector for Sustainability and Main Campus Administration

CO2 Level from 200 ppm in average in the last 800,000 years, increased to more than 400 ppm in 2013 and now **415 ppm!**

Human activity that has mostly caused **Global Warming** and **Climate Crisis** is too much using of fossil fuel



THAMMASAT

Therefore **Sustainable Development Goals** (SDGs) of UN : Why Partnership for the Goals (SDG 17) matters?

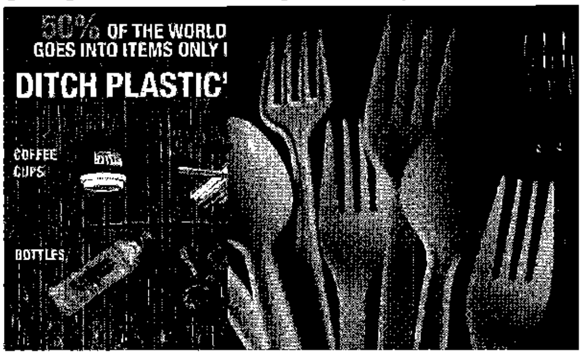
THAMMASAT

THAMMASAT

Responsible Consumption and Production (SDG 12) and Public Private Partnership of Thammasat

THAMMASAT

We don't need only garbage separation, but also garbage reduction! And begin with **Single Use Plastic!**

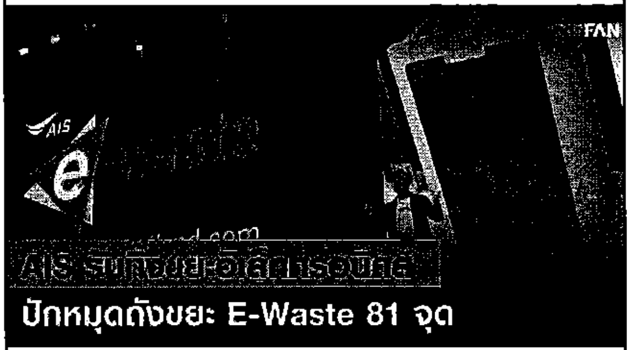


THAMMASAT

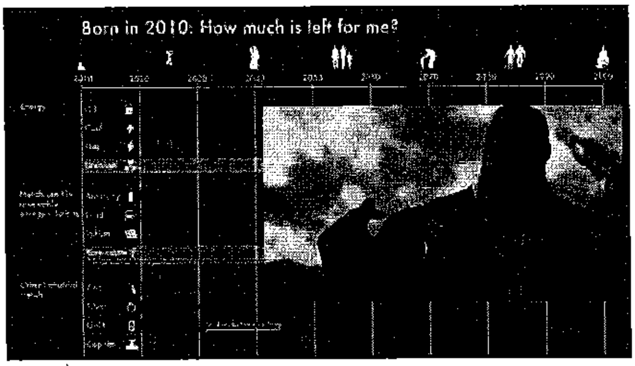
No More Single Use Plastic Action of Thammasat: Plastic Bags, Cups, Straws, Bottle, Utensils and etc.

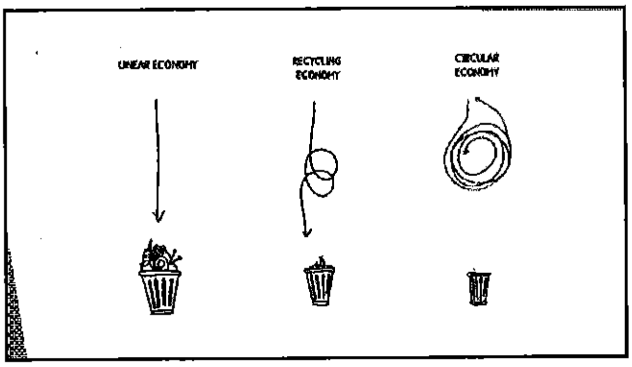
THAMMASAT

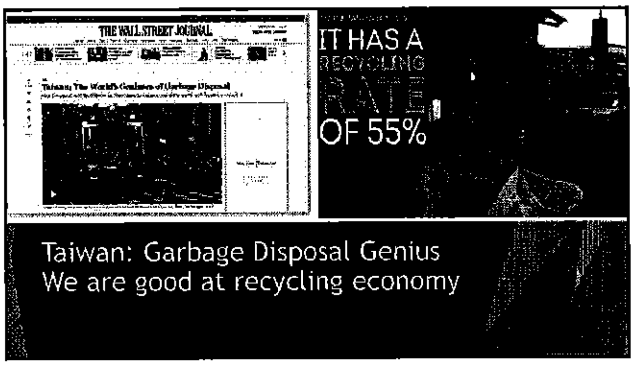
Waste management and also e-waste with the Concept of Public Private Partnership

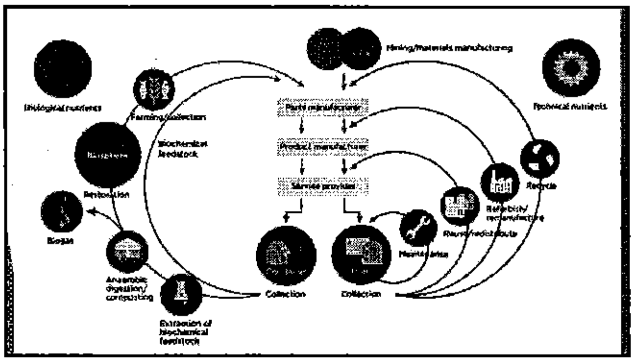


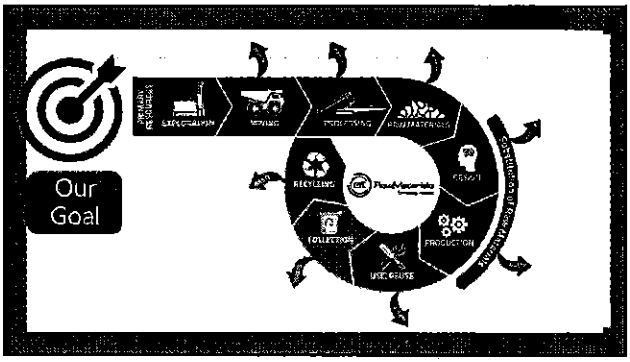

Strategic Alliance
Gimmy Chen


Born in 2010: How much is left for me?


LINEAR ECONOMY
RECYCLING ECONOMY
CIRCULAR ECONOMY

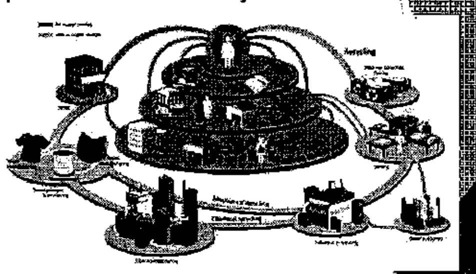

THE WALL STREET JOURNAL
Taiwan: The World's Geniuses of Garbage Disposal
IT HAS A
RECYCLING
RATE
OF 55%
Taiwan: Garbage Disposal Genius
We are good at recycling economy



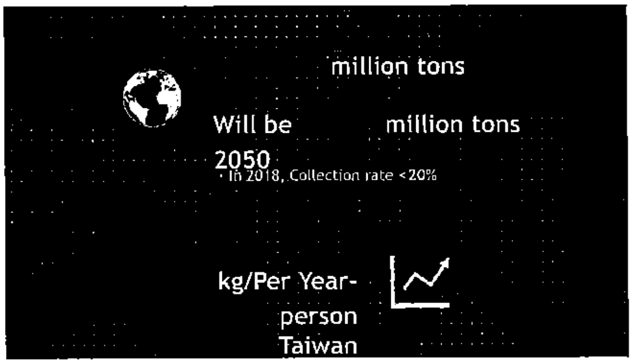


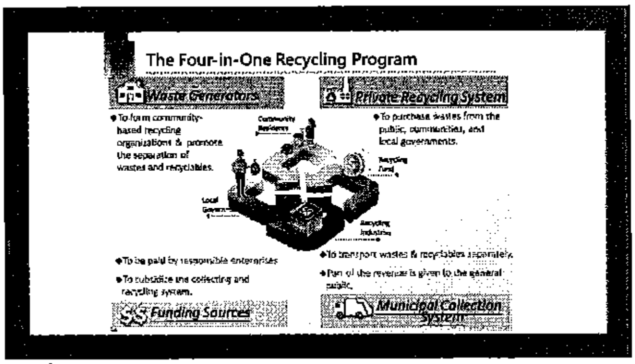
	What does CE mean?	What are CE's positive impacts?
Macro (countries, cities ...)	• Change purchasing habits (favor products & services with low environmental impact...) • Enforce laws, programs, frameworks related to CE	• Increase attractiveness thanks to value / job creations • Limit resources rarefaction and dependency on importations
Meso (inter-industries ...)	• Create inter-industries/firms networks • Deploy industrial symbiosis where companies exchange flows and mutualize needs	• Increase dynamism & attractiveness of territories • Reduce impact on environment • Create / relocate jobs
Micro (companies, consumers)	• Consume green (favor products with low environmental impact, recycling...) • Produce cleaner (eco-conception, offer services instead of products...)	• Reduce impact on environment • Provide competitive advantage (improved business model, new markets available...) • Improve brand image / reputation
Nano (product, component ...)	• Use / extract environmental-friendly goods • Increase life expectancy of goods through recycling, reuse, repairing	• Decrease extraction / consumption of raw materials • Increase value of second-use materials and goods

Example: Circular Economy

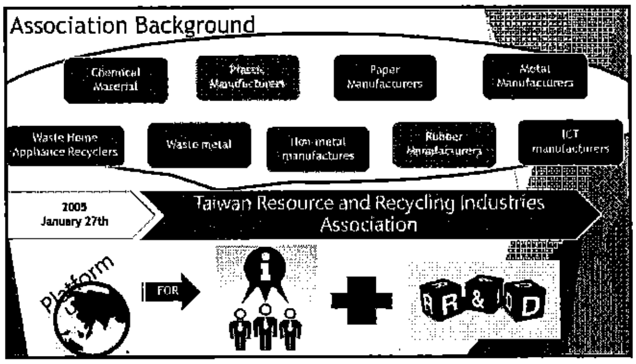


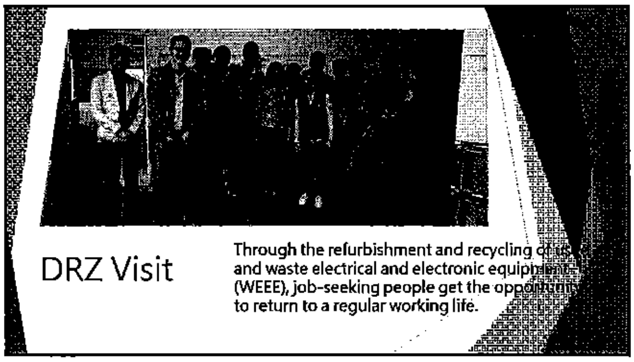
Reference : VTT

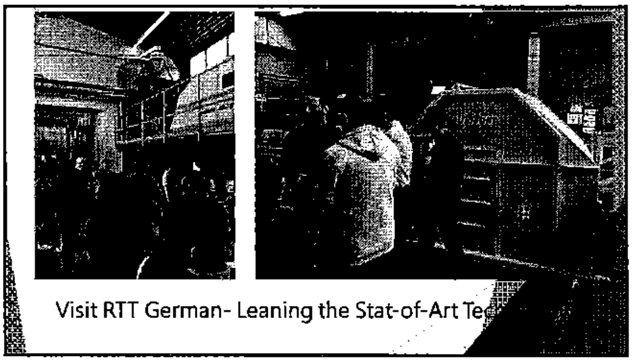

million tons
Will be million tons
2050
• In 2018, Collection rate <20%
kg/Per Year-person
Taiwan


The Four-in-One Recycling Program
Waste Generators
Private Recycling System
◆To form community-based recycling organizations & promote the separation of wastes and recyclables.
◆To purchase wastes from the public, communities, and local governments.
Recycling Industries
◆To be paid by responsible enterprises
◆To subsidize the collecting and recycling system.
◆To transport wastes & recyclables separately.
Funding Sources
Municipal Collection System

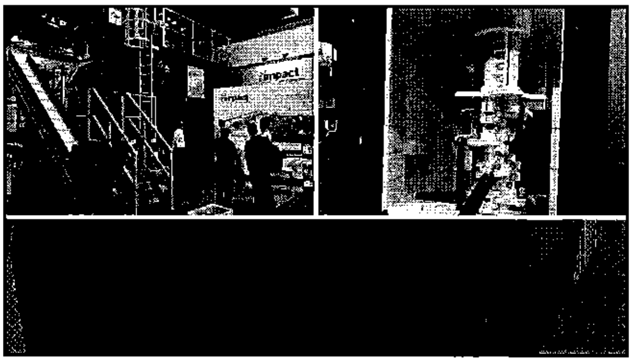

17 PARTNERSHIPS FOR THE GOALS
Strengthen the means of implementation and revitalize the global partnership for sustainable development

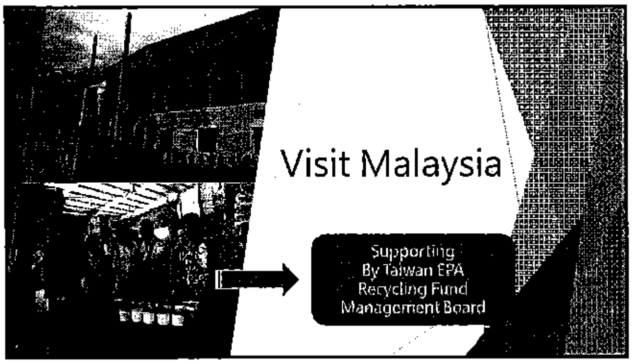

Association Background
Chemical Material
Paper Manufacturers
Metal Manufacturers
Waste Home Appliance Recyclers
Waste metal
Non-metal manufactures
ICT manufacturers
2005 January 27th
Taiwan Resource and Recycling Industries Association
Platform
FOR
R & D

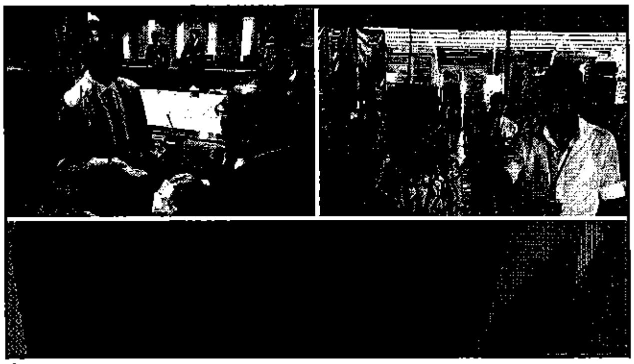

DRZ Visit
Through the refurbishment and recycling
and waste electrical and electronic equip
(WEEE), job-seeking people get the opp
to return to a regular working life.

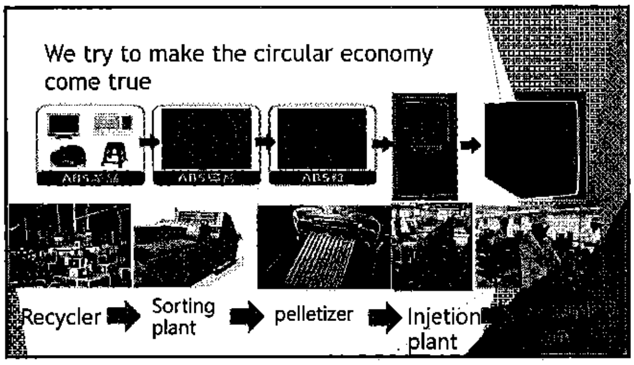

Visit RTT German- Leaning the Stat-of-Art Te

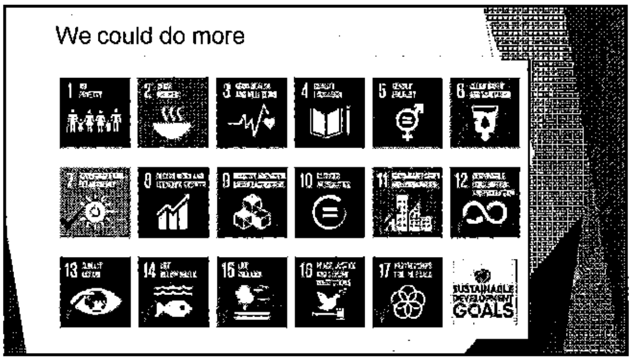

Visit MGG E-waste processing

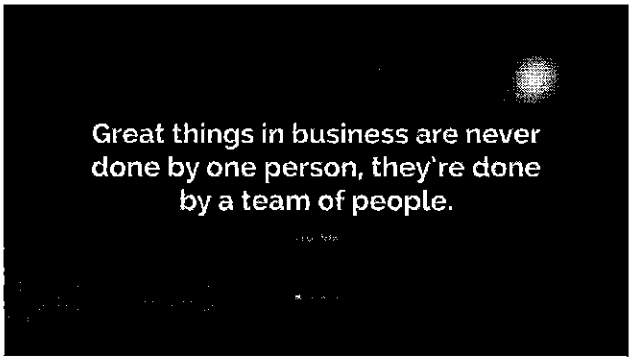



Visit Malaysia
Supporting
By Taiwan EPA
Recycling Fund
Management Board




We try to make the circular economy
come true
Recycler
Sorting
plant
pelletizer
Injetion
plant


We could do more
SUSTAINABLE DEVELOPMENT GOALS


Great things in business are never done by one person, they're done by a team of people.

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2019 International E-Waste Management Network (IEMS) Meeting

Project *"Strengthening of National Initiatives and Enhancement of Regional Cooperation for the Environmentally Sound Management of POPs in Waste of Electronic or Electrical Equipment (WEEE) in Latin American Countries"*

Alberto Santos CAPRA, Project Coordinator

Bangkok, Thailand, 2 - 4 December 2019

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UNIDO Project 2018-2022

13 Latin American and Caribbean Group (GRULAC) participating countries
Launched: Quito, Ecuador, March 2018

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UNIDO Project 2018-2022

❖**Main issues:** strengthening national capacities for national e-waste management with focus on POPs (particularly in plastics of EEE). Aligning national policies, knowledge and information about POPs in e-waste among government, technical staff and civil society.

❖**At National level it will help:**

✓Strengthen policies and train technicians and public officials, developing information and awareness.

✓Scale up existing infrastructure or establish new infrastructure where needed

✓Tailoring a ESM and final disposal strategy for brominated plastics considering (a) national, (b) regional and (c) BAT/BEP criteria.

✓Involve private e-waste dismantling/recycling facilities To upgrade technical standards in accordance to the SC/BC and other relevant criteria

❖**At Regional level:** enhancing regional cooperation on e-waste management with emphasis on POPs in e-waste policies, knowledge and information management systems, and South-South cooperation. It will work towards harmonizing key aspects of e-waste policies, strengthening regional cooperation, knowledge management and information exchange systems.

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UNIDO Project 2018-2022 Financials and Components

Components	GEF grant, USD	Co-financing, USD
Strengthening of national e-waste management initiatives	3,600,000	13,320,000
Strengthening of national capacities on e-waste dismantling and recycling facilities/infrastructure	3,900,000	43,340,000
Enhancement of Regional Cooperation on e-waste management	1,350,000	10,275,000
Project Monitoring and Evaluation	200,000	772,400
Project Management Costs	450,000	3,703,912
TOTAL MILLONS USD	**9,5**	**71,5**

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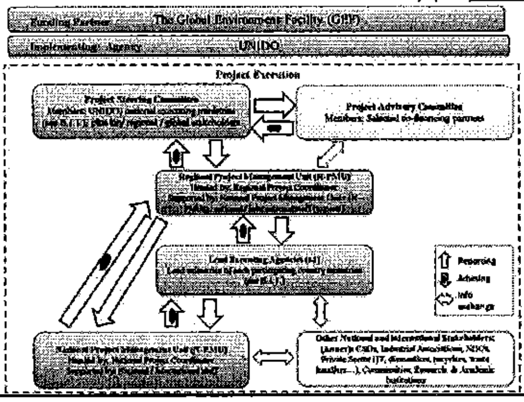
UNIDO Project 2018-2022 Implementation Structure



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UNIDO Project 2018-2022 BCRC Argentina

Executing agency for Argentina and Ecuador National Environmental Authorities

- ❖ **Component I: Strengthening National Initiatives**
- ✓ **Review or drafting of a National Policy, a National Strategy and a Financial Tool based on the EPR principle**
- ✓ **Curricula and research programs in universities; training program for relevant actors especially national**
- ✓ **National Information Systems for collection and processing data, prepared for the exchange of regional information**
- ✓ **Informed and aware society, including the media sector, through a National Communication Strategy**
- ❖ **Component II: Strengthening National Infrastructure**
- ✓ **Development of Sustainable Business Models**
- ✓ **Infrastructure Survey for improvement or expansion (scale-up) of two licensed establishments of WEEE management**
- ✓ **Segregation of plastics with POPs: target 135 tons/year, total 535 tons in 5 years of plastics with brominated POPs. Possible disposal in cement kilns by co-processing conforming directives of the Basel and Stockholm Conventions**

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UNIDO Project 2018-2022

❖**Component III: Enhancement of Regional Cooperation on e-waste management**

✓Comparative analysis of existing national policies / regulations is conducted to identify key issues that need to be addressed at the regional level

✓A **Regional Policy Platform** is operating to facilitate policy harmonization on key issues, with involvement of MEAs officials

✓A regional **Knowledge / Information System** is integrated into the policy platform; National information ones are linked to the regional

✓Knowledge sharing leads to strengthened country cooperation within the region

✓Regional post-project action plans and initiatives are developed

❖**Partners:** National governments, local WEEE recyclers, Regional Centres of SC and BC, the International Labor Organization (ILO), the International Telecommunication Union (ITU) and the World Health Organization (WHO), as well as several other partners , such as Dell, RELAC and the International Solid Waste Association (ISWA).

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¡Thank you!

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