

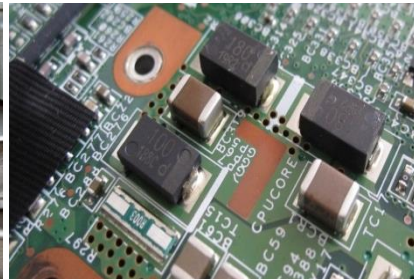
Status of the Project *Best of two Worlds*

Activities and Results in Ghana

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Recycling and Raw Materials Conference in Berlin, 24 March to 25 March 2014



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Summary

1 Background of the Project

2 Stakeholder Engagement

3 Numbers and Projections on E-Waste Generation

4 Determination of Optimal Pre-Treatment Depth

5 Determining Environmentally Sound Management Options for Negative Value Fractions

6 Analysis of Structural Hurdles

7 Outlook

The Project

Global Recycling of Strategic and Essential Metals: Best-of-two-Worlds Approach (Bo2W)

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Federal Ministry
of Education
and Research



Project Duration: June 2012 – May 2015

Background: disastrous recycling



Source: Oeko-Institut



Background: Critical metals are lost...



Source: Oeko-Institut

The challenge is

Challenges

- To reduce threats to human health and the environment
- To create better working conditions
- To close the loop of valuable metal cycles

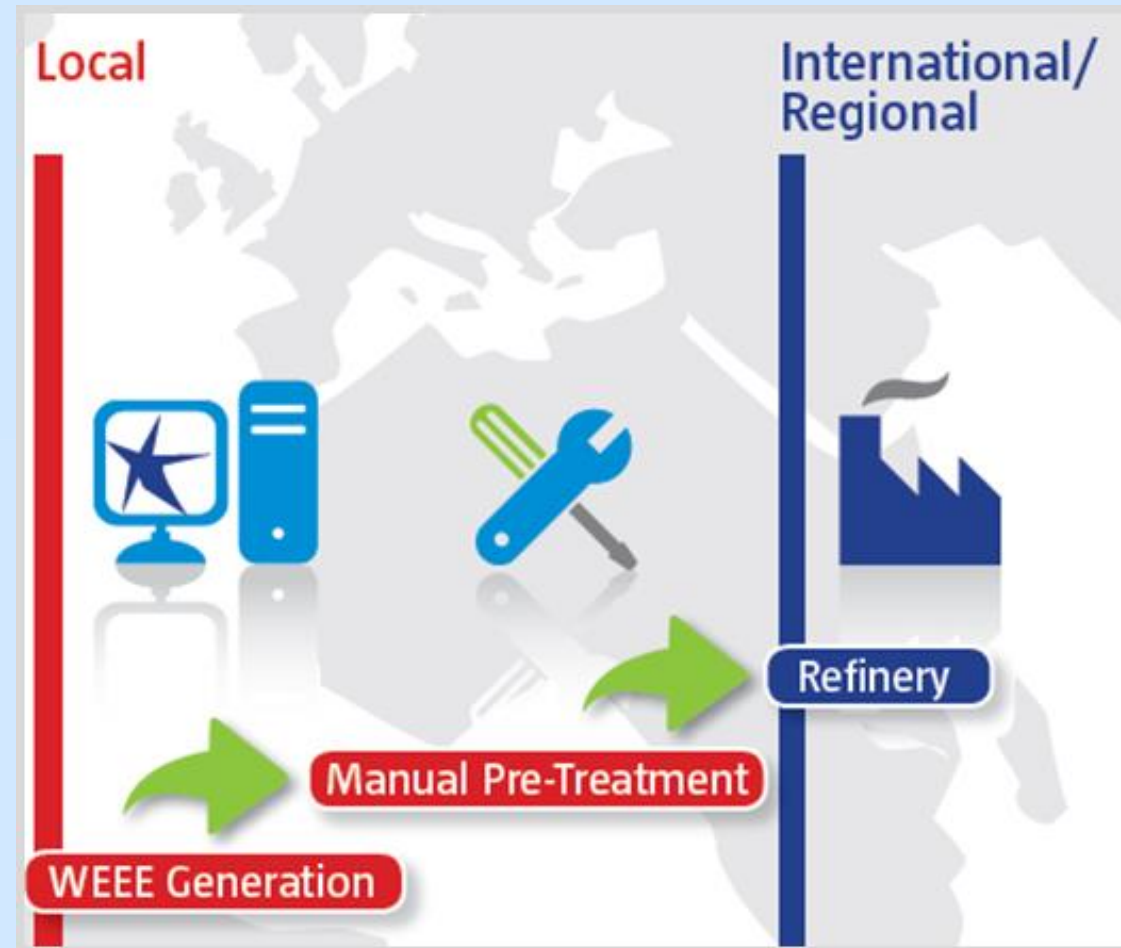
Focus of the project: electronic waste and end-of-life vehicles



Source: Oeko-Institut

The Bo2W approach:

**Bo2W
approach**



The Bo2W approach

Advantages

- Improved management of hazardous substances
- Increase of resource efficiency / closing global material cycles
- Reduced greenhouse gas emissions
- Generation of income and employment opportunities in Egypt and Ghana
- Increased investment in social and environmental standards

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Stakeholder engagement

- Policy
- Authorities/Administration
- Civil society
- Informal sector

Main events

- Stakeholder workshop held in June 2013 in Accra
- Milestone Workshop held in November 2013 in Hoboken



Stakeholder engagement

Tangible Results

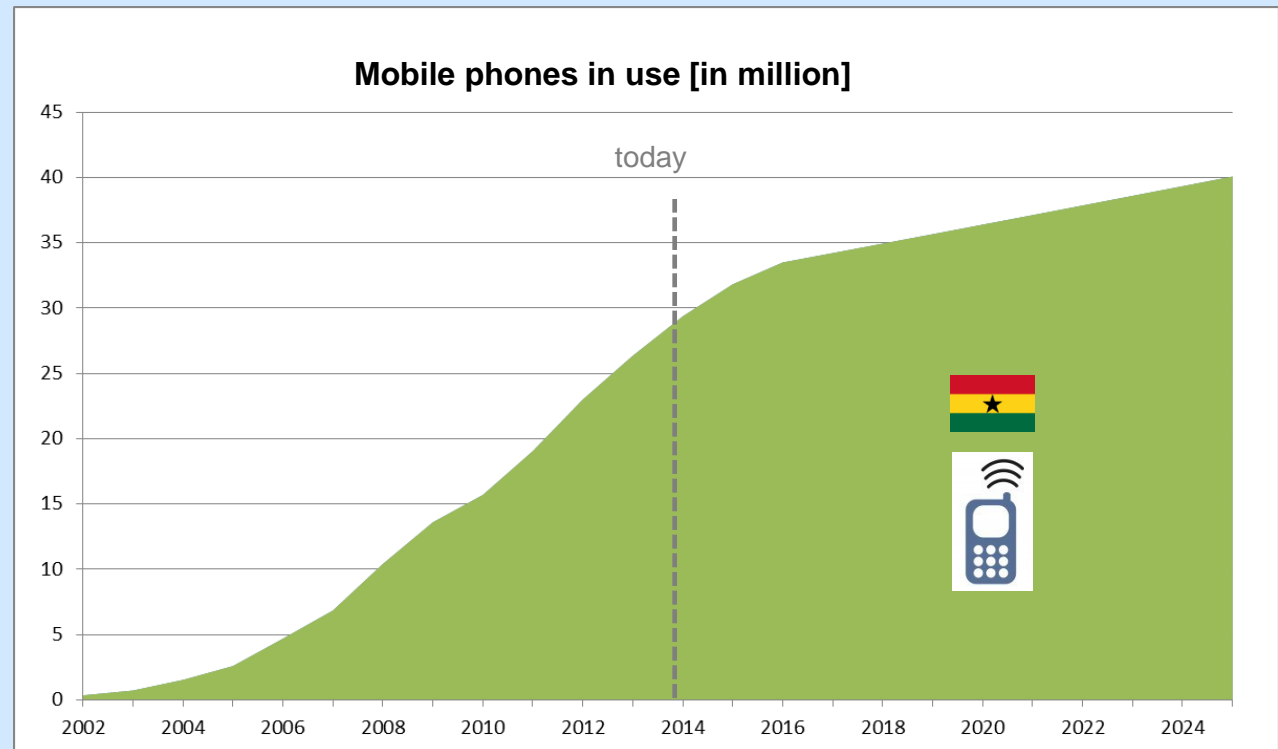
- Memorandum of Understanding between the Accra Scrap Dealers Association (informal sector) and the local partner, namely City Waste Recycling Ltd.
- Content:
 - The aim of the alliance is to develop suitable alternatives to particularly polluting procedures (such as the burning of cables).
 - The Scrap Dealers Association provides (complete units of) waste electrical and electronic devices to City Waste Recycling.
 - As regards its recruitment of personnel, City Waste Recycling employs people who have been working in the informal recycling sector.
- Official ban on export of waste batteries (lead-acid) that have been improperly handled

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Mobile phones in use in Ghana (2002-2025)

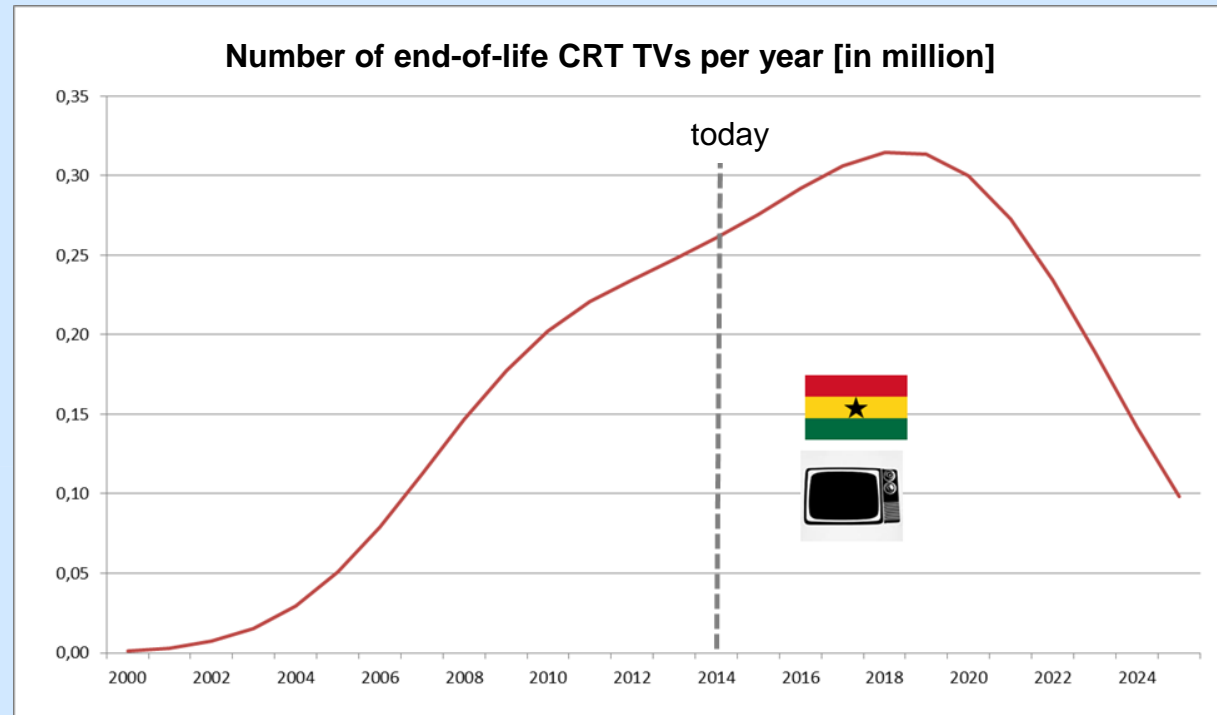
Mobile phones



- **Growing market**
- **Market saturation expected for around 2016**

Projection of end-of-life CRT TVs

End-of-life CRT TVs



Caution: Projections are based on various assumptions.

Moreover, there is the problem of illegal imports.

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Determination of optimal pre-treatment depth



- Know-how transfer
- Instructions on proper storage and transport
- Disassembly of hard disk drives

Summary

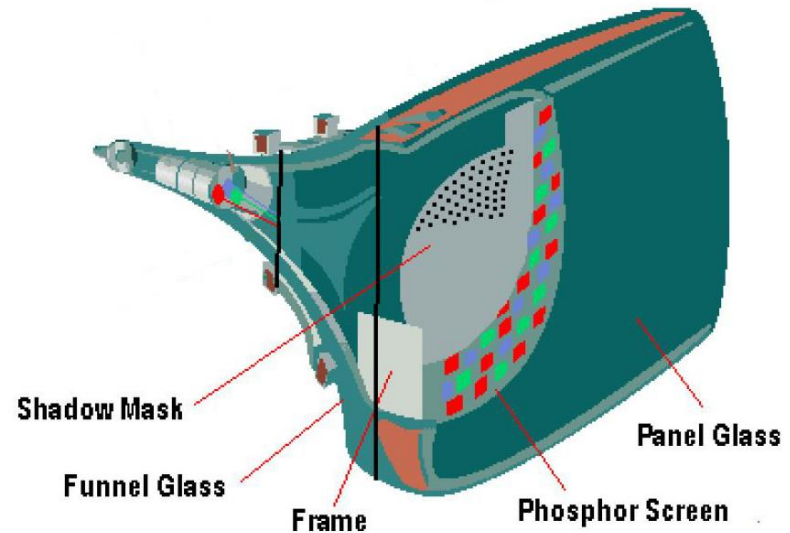
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Fraction 1 Cathode ray tubes

Set-up

CRT unit after dismantling:

- funnel glass
- panel (screen) glass
- metal frame
- shadow mask (inside unit)



Source: Townsend et al. 1999: Characterization of Lead leachability from Cathode Ray Tubes using the toxicity characteristic leaching procedure

Fraction **1** Cathode ray tubes

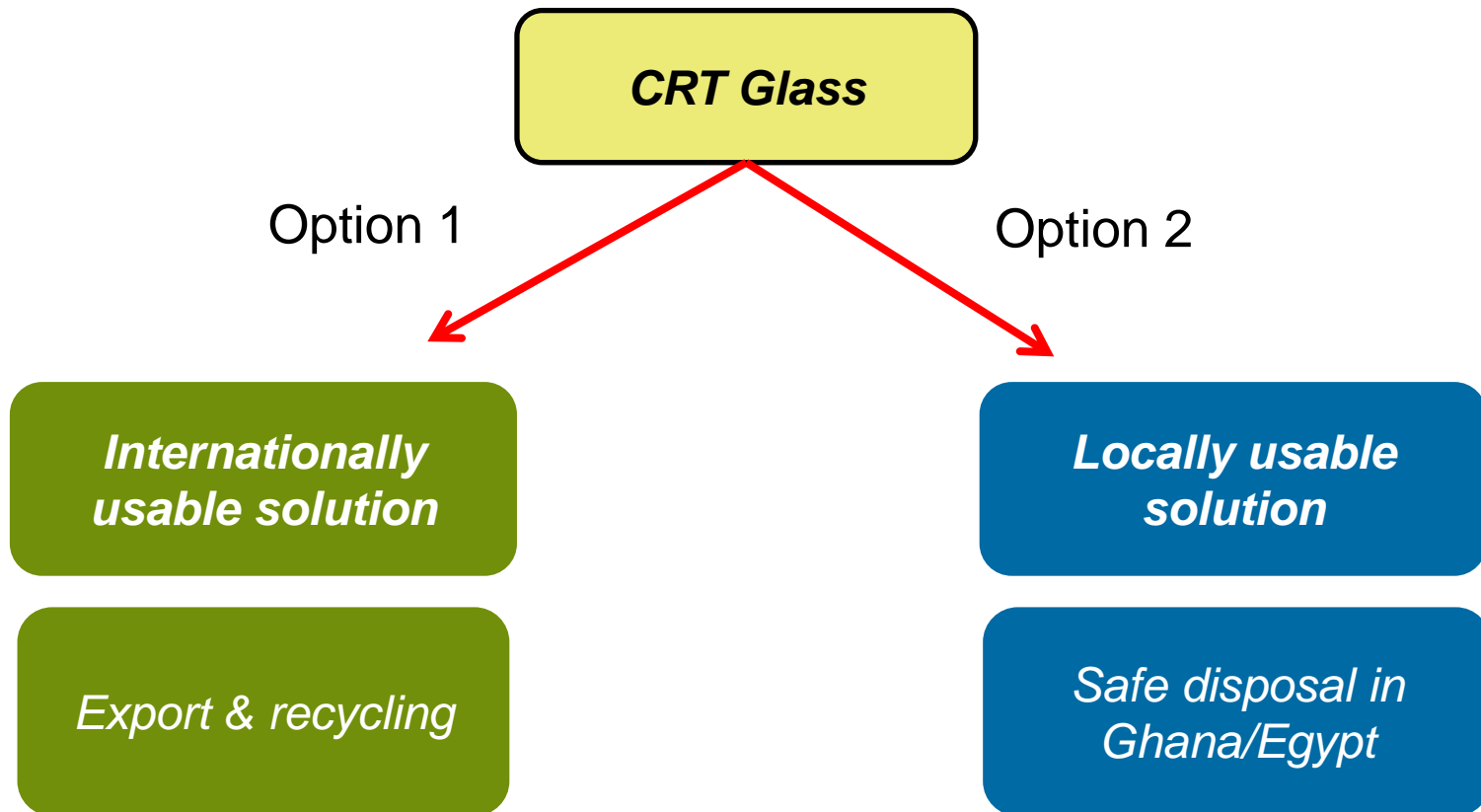
Costs for Recycling or Landfilling

Recycling path	Description	CPT* Cost (EURO/ton)
rp 2	funnel and screen glass to landfill	~ 26
rp 2 & rp 4	funnel glass to landfill & screen glass for other applications	~ 42-70
rp 3.1	funnel glass to lead smelter	~ 50
rp 3.1 & rp 4	funnel glass to lead smelter & screen glass for other applications	~ 50-75
rp 3.2	recovery of lead and glass	~ 150

Costs for transport and notification (Ghana to Deutschland) approx. 120 €/t

Fraction 1 Cathode ray tubes

Two Options



Fraction 2 Thermoplastics

The challenges

- From a quantitative point of view, housings of monitors and TVs are currently the most significant waste fraction.
 - Common practice: uncontrolled disposal
- Wide range of:
 - Types of polymers (ABS, HIPS etc.)
 - Types of flame retardants used, especially BFRs



Fraction **2** Thermoplastics

Proposed process optimization for Ghana and Egypt

- Reliable separation in plastic type and BFR content cannot be done without technical equipment.
- Pre-separation into **black TV plastics** (PS) and **white computer plastics** (predominantly ABS) will reduce separation efforts for plastic recyclers.
- Pure ABS/PC is the most valuable plastic fraction (~ 400 €/t).
- Baling and shredding of material needs to be organized prior to shipment.
- No need for notification if plastic content > 90 %.

Cost-neutral solution might be feasible.

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Structural Hurdles: Example 1

Electric cables



- Open cable burning is considered to be the most pressing problem in terms of e-waste faced by West Africa today.
- The cable fires of Nigeria, Ghana, Benin, Cote d'Ivoire and Liberia are estimated to contribute 0.15 - 0.3 % to the total EU dioxin emissions.

(Source: E-waste Africa Project – Where are WEEE in Africa?)

Structural Hurdles: Example 1

The project approach

- Mechanical preparation (shredding) and sorting of cables:
 - Need for knowledge transfer: Which shredder is to be used (in which way) for which type of cable? Need to consider several issues.
 - Substantial investments are requested (money to buy a shredder, sorting equipment and infrastructure to store copper and plastic fractions.)

Structural Hurdles: Example 1

Economic aspects...

- A cable shredder costs between 15,000 and 250,000 €.
- Individual shredders cannot cope with all cable thicknesses and types.
- Mechanical shredding and sorting of cables is usually associated with some copper losses in the range of 1-2 %.

Cable burning in contrast :

- is not dependent on investments (apart from money for matches);
- is not dependent on significant labour input;
- does not cause any significant copper losses;
- causes severe environmental damages.

Structural Hurdles: Example 2

Cathode ray tubes and televisions



- Funnel glass contains between 15 and 20 % lead.

Common practice in Ghana:

- Recovery of copper coil and other metals; uncontrolled dumping of CRT glass.

Structural Hurdles: Example 2

The project approach



Environmentally sound management of all e-waste fractions – including negative value fractions such as CRT glass.

Structural Hurdles: Example 2

Economic aspects...

- No evidence of any environmentally sound management option available in Ghana and Egypt.
- In EU countries, costs associated with environmentally sound waste management solutions range between 26 and 150 € / t.
- Transport and notification involve additional costs of approx. 120 € / t.
- Glass makes up ~ 50% of the total weight of CRT TVs.

Structural Hurdles: Example 2

Ray tube televisions:

Fraction	Weight [g]	Value [US\$/kg]	Transport costs [US\$/t]	Net-value [US\$]
Case (plastics)	4196	-	-	-
CRT glass	11884	-0.1	154	- 3.02
Copper	1995	5	142	9.69
Steel	378	0.3	13	0.11
PWBs	3461	0.26	142	0.16
Others	2226	-	-	-
Total	24140			6.94

- The problem is that informal recyclers earn more money (by externalising costs).
- This gives them a strategic advantage in e-waste collection.

+ 9.96 US\$



Structural Hurdles: Example 3

Example of lead-acid batteries



- Informal lead-acid battery recycling was classified as the world's worst pollution problem in 2012 (Blacksmith Institute 2012).

Common practice in Ghana:

- Export of drained lead-acid batteries.

Structural Hurdles: Example 3

The project approach



Export of undrained lead-acid batteries from Ghana to Germany for sound recycling (including acid) at Johnson Controls' Krautscheid facility.

Structural Hurdles: Example 3

Economic aspects...

- The acid is a negative-value fraction – sound management is associated with costs of around 120 € / t.
- The acid corresponds to 13-15% of the total battery weight.
- A 40 ft shipping container can be filled with 23 t of batteries.

Compared to players exporting drained lead-acid batteries, in the project model

- The quantity of lead that can be transported per container is reduced by 13 - 15 %. In addition, the costs for the disposal of the acids have to be included in the calculation.
- there are thus lower revenues per container (4,600 € less).

Interim result

- In comparison to the informal sector, formal recycling enterprises face structural disadvantages.
- In essence, these disadvantages result from the fact that costs are externalised when informal recycling practices are applied (pollution → impacts on human health and the environment).
- This disadvantage needs to be addressed.

At the same time it must be emphasized that:

- 80 % of the Ghanaian workforce is employed in the informal sector.
- It is highly unlikely that waste management and recycling activities will be completely formalised within the next years.

Interim result

- It is necessary to ensure that fractions that are critical in view of environmental and resource protection will only be treated in environmentally sound recycling facilities.
- However, the question remains on how this should be achieved in practice?

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Possibility 1 Improved access to downstream markets

Idea:

- Dubious business practices on the part of intermediate agents result in income losses suffered by collectors and dismantlers;
- If formal recycling enterprises had direct access to sales markets, they would be in a better position in economic terms.
- This is being tested in the framework of the Bo2W-project.

Limitations:

- Most recyclers in developing countries and emerging economies are still quite small, not (yet) playing a crucial role on the world market in terms of quantities.
- Developing the market access for such enterprises is a challenging task.

Possibility² Focus on a B2B model

Idea:

Affiliates of international companies and public institutions do not want to want to be connected with polluting recycling practices.

- Therefore, they are often willing to deliver e-waste and car-waste to formal recyclers.
- In contrast to e-waste and car-waste from households and small businesses, competition in this segment is not only based on price but also on the quality of the recycling processes.

Limitations:

- While this model might be a good starting point, it is not capable of addressing e-waste and car-waste from households and small businesses.

Possibility 3 Ban polluting practices

Idea:

- If polluting practices (e.g. burning of cables, uncontrolled disposal of CRT glass) were to be prohibited and if appropriate measures were to be taken, a *level playing field* could be created.
- In some few cases, bans can be implemented and monitored without too much effort – such as a ban on exports of drained lead-acid batteries.

Limitations:

- Enforcing bans in informal recycling sectors is extremely difficult since structures are substantially opaque.
- Evidence from other countries shows that bans can result in the continuation of some practices, with the sole difference that practices that had been fairly public and visible before will be executed in back-yards then.

Possibility 4 Financing via an extended producer responsibility scheme

Idea:

- “Producers” (players that bring products on the market) are held responsible for environmentally sound management of an e-waste / car-waste volume equivalent to that brought onto the market.
- Producers can either establish their own management system or make a financial contribution to collection and recycling schemes.

Limitations:

- Some types of EPR financing systems are vulnerable to corruption.
- While leading manufacturers are predominantly in favour of such systems, there is a large number of small importers, most of whom are not registered.

Possibility **5** Providing Start-up Capital

Idea:

- Formal recycling companies have to cope with cash-flow problems, especially in the beginning phase: While they have to pay for the costs incurred for collection, processing, storage and transport, they only receive the returns of this investment some weeks after shipment of the fractions.
- Medium credits can help to bridge these gaps and enable a more rapid business growth.
- Rapid growth opens up the possibility to use economies of scale.

Limitations:

- In developing countries and emerging economies, interest rates for this type of business model are usually relatively high.

Discussion

5 Possibilities:

- Improved access to sales markets
- Focus on a B2B model
- Ban of polluting practices
- Financing via an extended producer responsibility scheme
- Providing start-up capital

Many Thanks for Your Attention!

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