Introduction to the study on the feasibility of international e-waste recycling co-operations between Ghana and Europe

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Siddharth Prakash, Öko-Institut e.V.
Andreas Manhart, Öko-Institut e.V.

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Criteria

- Important share of total e-waste volumes in Ghana

- High environmental concern

- Possible economic incentives and social benefits

- Serves as a model for the recycling of other product groups with similar characteristics

→ Desktop-PC, Refrigerators, CRTs

Key steps

- Analysis of presently applied recycling technologies

- Analysis of best applicable recycling technologies

- Analysis of environmental, social and economic benefits

- Sketching possible business models with special focus on the informal structure

→ Analysis based on the field data collected for the socio-economic assessment, and studies carried out for component 1 and 2 of the E-Waste Africa project

→ Technical information from scientific literature and related publications

Presently applied recycling practices in Ghana

- Collection by informal waste collectors

- Removal of functioning components for re-use (cables, memories, drives…)

- Manual dismantling to extract steel-, aluminium- and copper parts and open incineration of cables and components to recover copper

- Disposal of residues

Best applicable recycling practices

- Collection
  - Municipal collection points, like in Europe → **?????**
  - Informal door-to-door collection, like in many developing countries

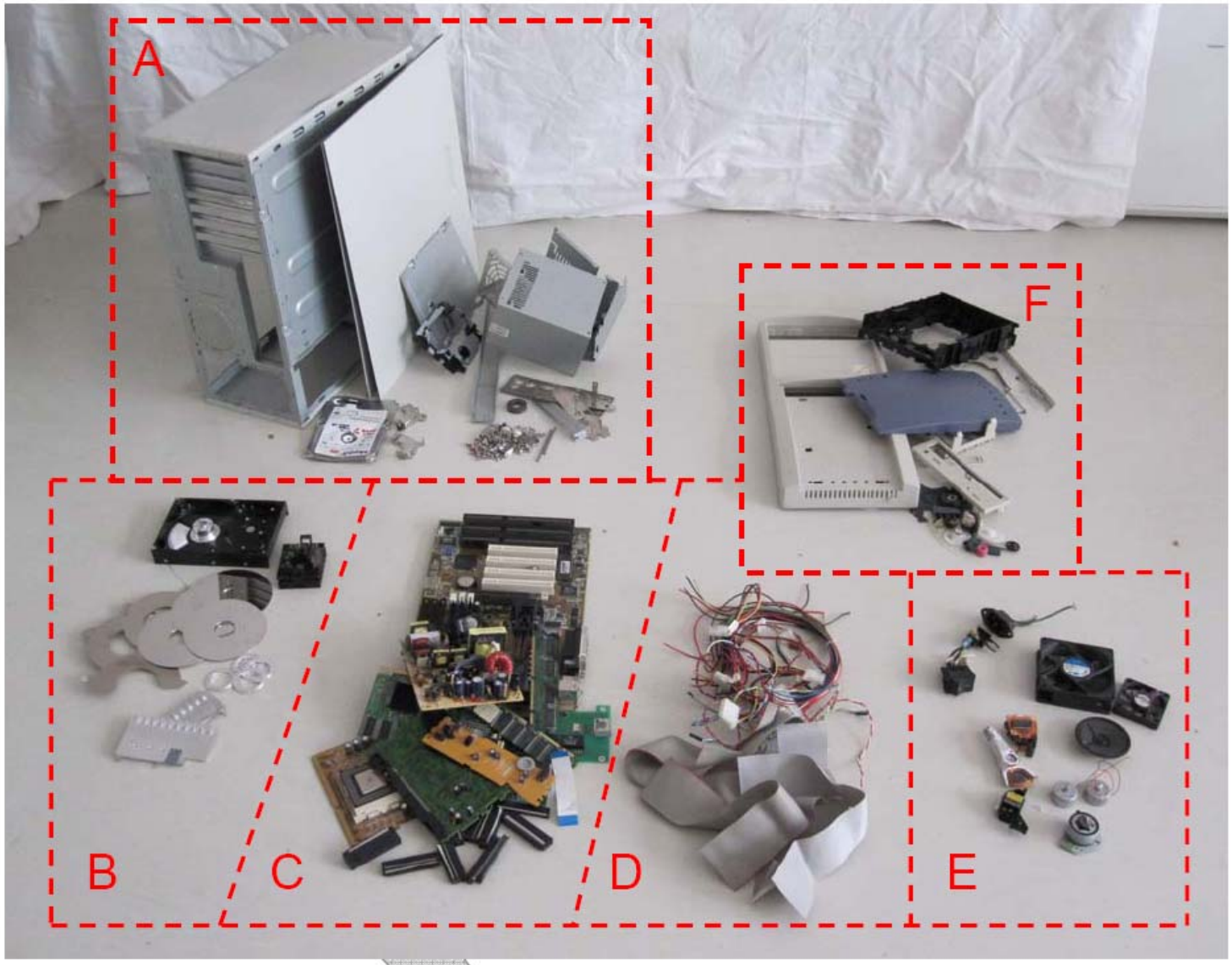
- Pre-processing
  - Mechanical shredding and sorting
  - Manual dismantling and sorting

Pre-processing

- Mechanical shredding and sorting
    - does not achieve perfectly pure output fractions, thus, comparatively lower material recovery potential (precious metal losses range between 20 – 58%)
    - economically preferable under Central European conditions

- Manual dismantling and sorting
    - output fractions of much higher quality, thus, losses can be minimised in subsequent refinery processes

E.g. Desktop Computer



A = steel scrap
B = Aluminium scrap
C = High grade precious metals fraction
D = Copper cables
E = Low grade copper and precious metal fraction
F = Plastic fraction

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Pre-processing

-Mechanical shredding and sorting

- does not achieve perfectly pure output fractions, thus, comparatively lower material recovery potential (precious metal losses range between 20 – 58%)
- preferable under Central European conditions

- Manual dismantling and sorting

- output fractions of much higher quality, thus, losses can be minimised in subsequent refinery processes
- even with manual dismantling, some components (such as small motors, cables…) containing copper and precious metals might still have to undergo pre-treatment
- economically preferable in regions with lower wage levels

Best applicable recycling practices

- Collection
  - Municipal collection points, like in Europe → **?????**
  - Informal door-to-door collection, like in many developing countries

- Pre-processing
  - Mechanical shredding and sorting
  - Manual dismantling and sorting

- End-processing
  - high material recovery & high environmental standards
  - steel scrap → electric arc furnaces (Ghana **??**)
  - aluminium scrap → aluminium remelters (Ghana **??**)
  - precious metal scrap → pyrometallurgical refineries overseas
  - plastic scrap → power plants or cement kilns (availability Ghana **??**)

Interim conclusions

- House-to-house collection of e-waste

- Manual pre-treatment, including deep dismantling until the level of parts of sub-components

- Refinery of steel and aluminium fractions in domestic plants

- Refinery of high-grade precious metal fractions in pyrometallurical refineries overseas

- Further mechanical pre-processing of complex parts like motors and reading/ writing devices of drives

- Controlled incineration/ energy recovery of remaining plastic fraction

Economic incentives for environmentally sound international recycling cooperation

	Amount contained in a PC [g/unit]	Average material price 2007 [US$/t]	Intrinsic material value 2007 [US$/unit]	Estimated recovery rates with presently applied technology	Estimated recovery rates with best applicable technology	Net material value with presently applied technology [US$/unit]	Net material value with best applicable technology [US$/unit]
Steel	6737.501	253*	1.70	95%	95%	1.62	1.62
Plastics	1579.545	310**	0.49	0%	0%	0	0
Aluminium	550.212	2700	1.49	88%	78%	1.31	1.16
Copper	413.225	7231	2.99	85%	98%	2.54	2.93
Zinc	25.940	3400	0.09	0%***	0%***	0	0
Tin	19.573	19800	0.39	0%	0%***	0	0
Antimony	18.577	5660	0.11	0%	0%***	0	0
Nickel	12.700	37200	0.47	0%***	0%***	0	0
Lead	6.585	2730	0.02	0%	0%***	0	0
Silver	1.702	550000	0.94	0%	87%	0	0.81
Gold	0.260	22400000	5.82	0%	93%	0	5.42
Palladium	0.120	11488748	1.38	0%	91%	0	1.25
Chromium	0.015	2010	0.00	0%***	0%***	0	0
Ceramics & others	371.909	-	-	-	-	-	-
Sum	**9737.860**		**15.88**			**5.47**	**13.19**

** Prices for iron and steel scrap* *** Prices for mixed plastics* **** Indirectly recovered together with other metals*

Source: Gmünder 2007, USGS 2009a, USGS 2009b, CSR 2009.

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Environmental benefits of international recycling cooperation

- Environmental impact of secondary production from the recycling of 1 desktop computer

- Environmental impact of primary production of the same amount of materials used for the production of 1 desktop computer

- Example: Using the state-of-art technologies, emissions of about 20 kg of CO_2 eq. per desktop computer are reduced

Health & safety issues and labour intensity

- Minimum safety instructions during dismantling operations for different product groups

- High labour intensity
  - China: 83 working hours for dismantling approx. 100 desktop computers
  - Germany: 7.5 workings hours for dismantling approx. 100 desktop computers
  - **Ghana: similar working conditions like in China**

Interim conclusions

- Significant untapped economic, environmental and social improvement potentials in recycling practices

- Business in Ghana relatively independent from investments in machinery parks and infrastructure

- The investment into comprehensive pre-processing machinery would on the contrary reduce the economic potentials of this approach and also have negative impacts on employment creation

- The manual pre-processing operations can be run by medium and low skilled workers. Therefore the business is suitable to be implemented within or attached to the current informal sector recycling in Ghana

Possible business models – Prerequisites

- Establish and maintain contractual links between pre-processing operations in Ghana and pyrometallurgical refineries in Europe, Canada or Japan

- At least one actor that is capable of handling administrative issues related to the transboundary shipment of e-waste

- Insure steady and reliable cash flow to the involved workforce

- Insure a steady know-how transfer to the recycling sector in Ghana

Possible Business Models

- **Model 1: Indirect co-operation with one or more intermediaries**

- **Model 2: Direct co-operation between small scale recyclers and refineries**

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Contact:

Siddharth Prakash

Email: s.prakash@oeko.de

Phone: ++49 (0)761 4529544

Fax: ++49 (0)761 4529588

Andreas Manhart

Email: a.manhart@oeko.de

Phone: ++49 (0)89 12590077

Fax: ++49 (0)761 4529588

Web: www.oeko.de

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