# Hazardous occupational and community exposures in informal e-waste recycling

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## Economic considerations

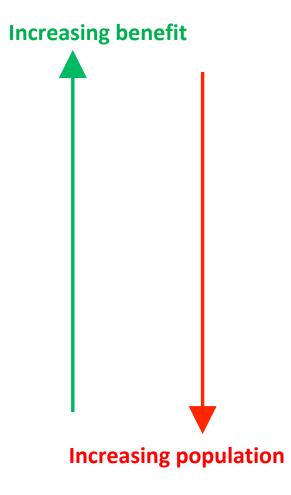


Table 1. Hierarchical structure of e-waste from Agbogbloshie.

Role in E-Waste Circuitry	Estimated Average Monthly Income (USD) *	Percent of Ghanaian Daily Minimum Wage *		
Global Firm	N/A	N/A		
International Firm	\$20,000+	N/A		
Scrap Dealer	\$1500	2747%		
Middleman	\$1050	1923%		
Refurbisher	\$190-\$250	348%-458%		
Recycler	\$175–\$285	321%-522%		
Scrap Collector	\$70-\$140	128%-256%		
Child Laborer	≤\$20	≤36.6%		

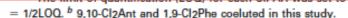
<sup>\*</sup> Income and wage figures are calculated using



#### "Typical" e-waste exposure study

TABLE 1. Limit of Quantification and Mean and Ranges of Concentrations<sup>a</sup> (ng/g dry wt) for Individual CIPAHs in Electronic Shredder Waste, Leaves, Floor-Dust, and Soil Samples from an e-Waste Recycling Facility, a Chemical Industrial Complex, and from Other Locations

			e-was	te recycling facility		industrial	other locations		
compound	LOQ	electronic shredder waste n=5	leaf n=6	floor-dust	soil n=10	urban soi (reference	soil	rural soil (reference) n=2	agricultural soil n=7
Compound	Lou	,, ,	" "	" "	<i>n</i> 10				
9-CIFle	0.12	ND	ND	ND	ND	ND	ND	ND	ND
9-CIPhe	0.09	ND	16.9 (3.67-28.1)	ND	0.49 (ND-2.76)	ND	ND	ND	ND
2-CIAnt	0.36	ND	ND	ND	ND	ND	ND	ND	ND
9-CIAnt	0.17	ND	ND	ND	0.05 (ND-0.53)	ND	ND	ND	ND
3,9-Cl <sub>2</sub> Phe	0.20	0.94 (ND-1.65)	5.59 (2.86-9.82)	0.41 (ND-2.06)	0.15 (ND-1.53)	ND	0.37 (ND-4.49)	ND	ND
<sup>b</sup> 9,10-Cl <sub>2</sub> Ant/	0.21	ND	1.84 (0.75-2.64)	1.38 (ND-6.88)	0.09 (ND-0.51)	ND	ND	ND	ND
1,9-Cl <sub>2</sub> Phe									
9,10-Cl <sub>2</sub> Phe	0.06	ND	3.01 (1.58-5.09)	0.73 (ND-2.22)	ND	ND	0.13 (ND-0.56)	ND	ND
3-CIFlu	0.13	0.52 (0.46-0.65)	7.95 (1.24-16.5)	3.72 (2.44-5.91)	0.49 (ND-2.67)	ND	0.73 (ND-2.50)	ND	0.05 (ND-<0.13)
8-CIFlu	0.14	13.2 (8.23-20.4)	4.34 (1.27-7.80)	9.40 (1.31-15.6)	1.25 (ND-6.59)	ND	0.01 (ND-<0.14)	ND	ND
1-CIPyr	0.15	14.9 (7.48-26.7)	27.7 (15.8-44.8)	16.6 (6.86-31.8)	4.06 (ND-11.0)	ND	4.58 (ND-36.7)	ND	ND
3,9,10-Cl <sub>3</sub> Phe	0.14	5.43 (4.19-6.39)	7.00 (3.73-11.7)	5.32 (ND-13.3)	1.87 (ND-5.69)	ND	0.20 (ND-2.45)	ND	ND
5,7-Cl <sub>2</sub> Flu	0.17	ND	ND	ND	ND	ND	ND	ND	ND
3,8-Cl <sub>2</sub> Flu	0.18	ND	ND	ND	ND	ND	ND	ND	ND
3,4-Cl <sub>2</sub> Flu	0.18	ND	ND	ND	ND	ND	ND	ND	ND
6-CIChr	0.15	ND	ND	ND	ND	ND	ND	ND	ND
7-CIBaA	0.27	10.6 (4.00-21.3)	9.64 (ND-40.6)	22.5 (ND-33.8)	2.24 (ND-13.0)	ND	0.69 (ND-8.29)	ND	ND
6,12-Cl2Chr	0.13	ND	ND	ND	0.09 (ND-0.85)	ND	0.38 (ND-2.48)	ND	ND
7,12-Cl2BaA	0.13	ND	ND	ND	ND	ND	0.71 (ND-4.75)	ND	ND
6-CIBaP	0.27	13.5 (5.84-25.3)	3.59 (ND-6.96)	43.3 (21.1-66.9)	16.0 (ND-73.1)	ND	80.2 (6.73-231)	0.19 (ND-<0.27)	0.10 (ND-<0.27)
ΣCIPAHs		59.1 (32.3-101)	87.5 (46.0-111)	103 (37.2-139)	26.8 (ND-96.4)	ND	88.0 (13.2-278)	0.19 (ND-0.38)	0.15 (ND-0.76)
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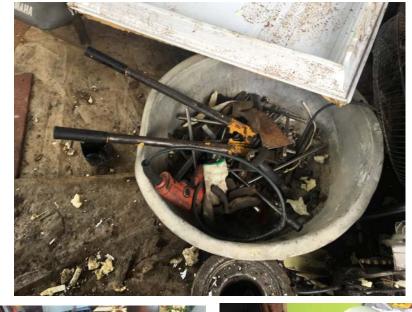
#### Occupational concerns

 Workers have (much) higher exposures to hazards than communities

• Workers create hazards for communities



- Skin contact with heavy metals
- Inhalation of air contaminants
- Injury risk (cuts, struck-by)
- Musculoskeletal issues
- Burns
- Noise









#### Occupational concerns

- Common exposures (continued)
  - Infectious agents
  - Heat stress
  - Food/water access
  - Food/water contamination
  - Inadequate sanitation









#### Community concerns: general

General ecological degradation

Air pollution

Water pollution

Soil/food contamination









More vehicular traffic

# Community concerns: crops

 Crop production near informal e-waste recycling activities



Harm to pollinators









### Community concerns: livestock and wildlife

 Animals grazing/feeding near e-waste recycling activities

Contamination of meat

Sickened/dead animals









#### Community concerns:

#### water bodies

 E-waste recycling activities often occur near ponds and rivers



 Sickened/dead aquatic life







# Community concerns: food preparation and storage

 Preparation of food on same surfaces where ewaste recycling activities occur

 Other potential contamination issues (e.g., pesticide and chemical storage)









## Community concerns: children

 Families in close proximity to ewaste recycling

 Children may have worse exposures (behavior) and health outcomes (developmental stage)







#### Community concerns: access to services

- Many informal recyclers in poor health (though not necessarily due to e-waste)
- Access to physical/mental healthcare limited or entirely out of reach
- Illegal e-waste recycling activities further reduces access



#### So...what *don't* we know?

- Lots of studies of human exposures, environmental contamination
- Fewer studies connecting these two types of information
- Relatively few studies on health outcomes
  - Most studies focus on a few sites







#### Questions?

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