Sustainability and life cycle analysis in informal e-waste recycling

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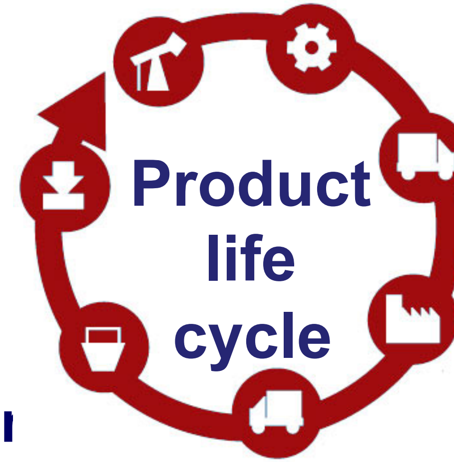
Needs and objectives



Electronic recycling has been studied in multiple LCA… but

→ Little quantitative data available for the informal sector

→ Need to understand the combined environmen economic performance of the different EOL scenarios

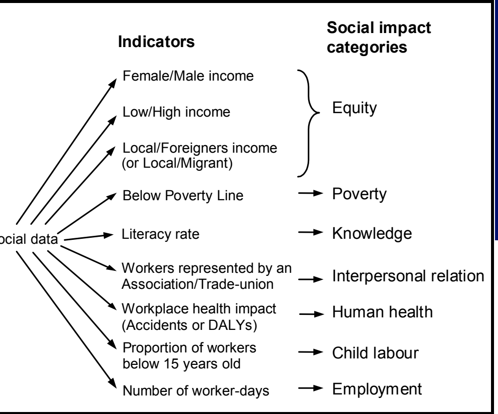
→ Need to also understand the occupational risk of chemical exposures and injuries associated with informal recycling

Objectives:

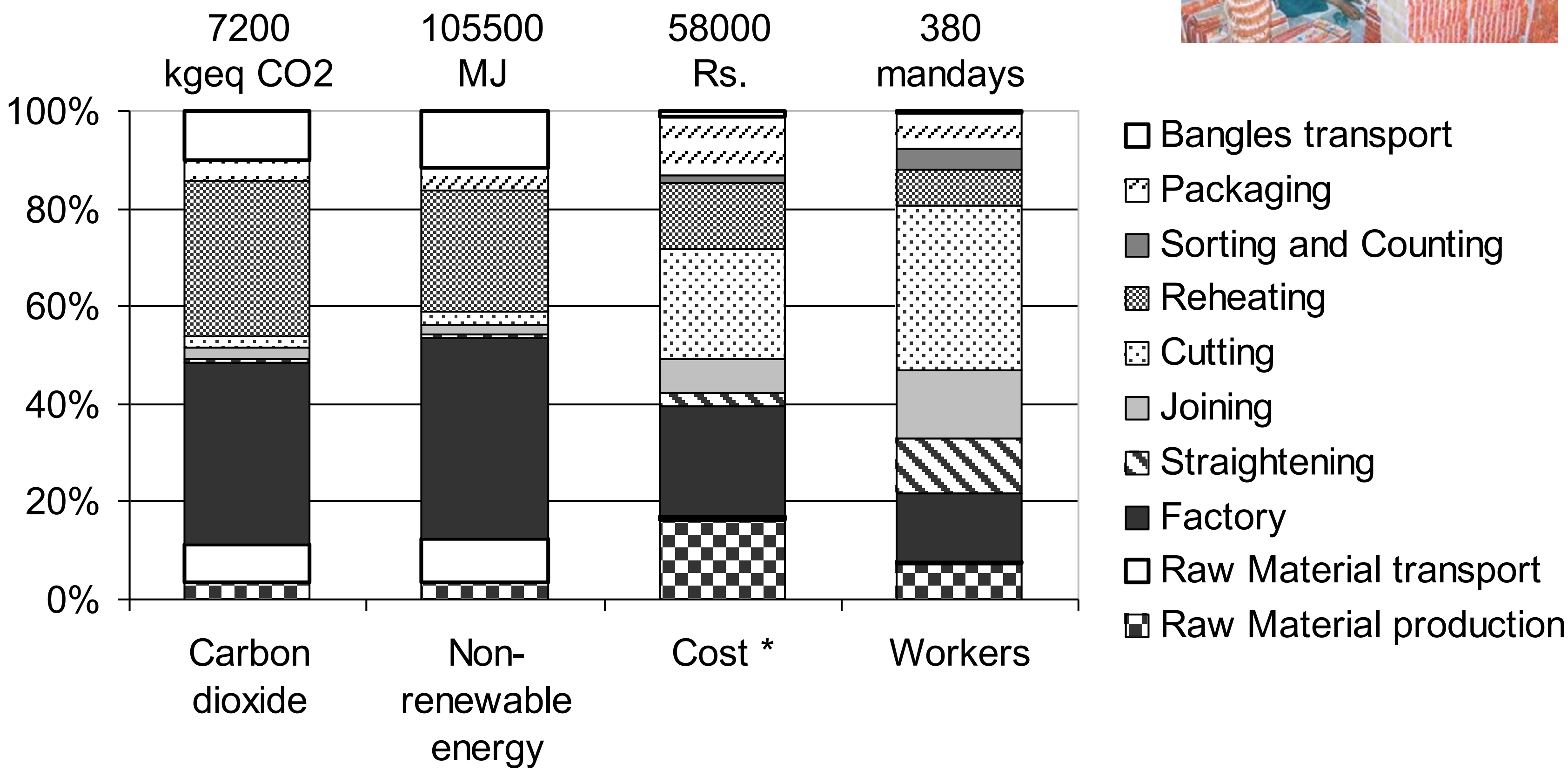
Develop a life cycle based approach that enables to evaluate the socio-economic, occupational and environmental risks and benefits associated with multiple electronic products

→ Mitigate risks, while maintaining economic and environmental benefits.

ocial & LCA: Glass bangles production in India

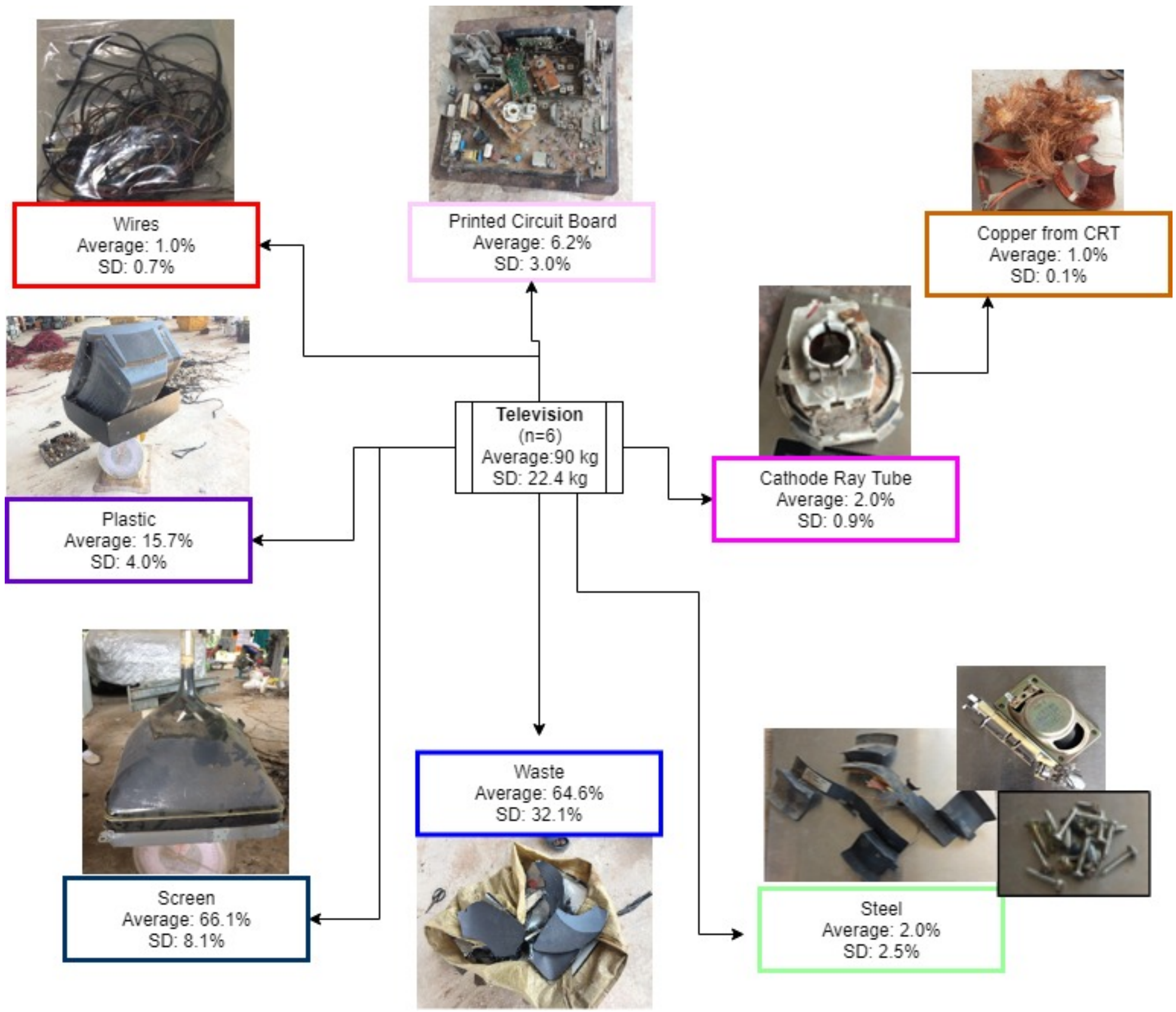


The production of 1000 toras involves...

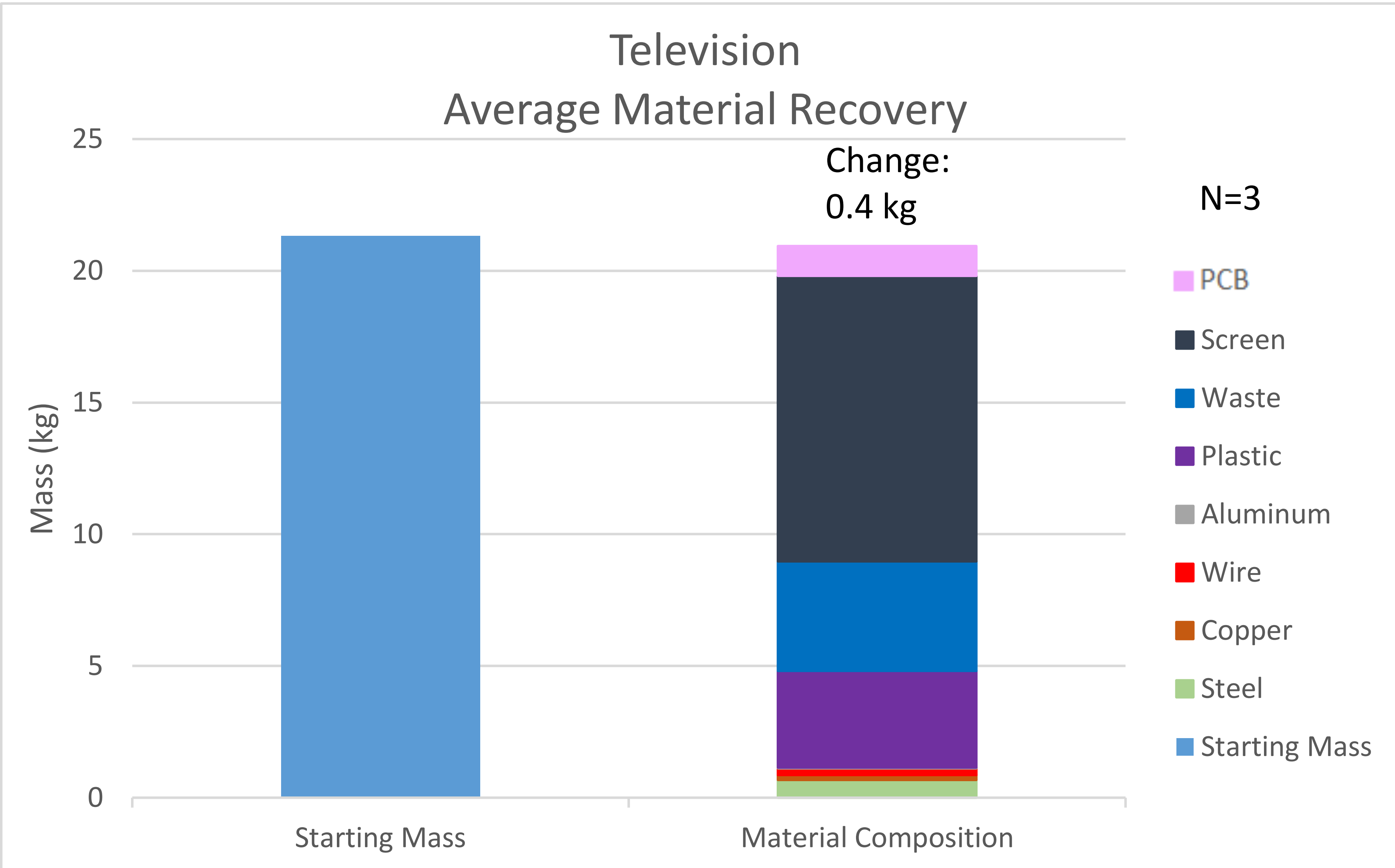


Roquier and Jolliet, Social Life Cycle Assessment, 2015

Stepwise analysis of the informal recycling process: television

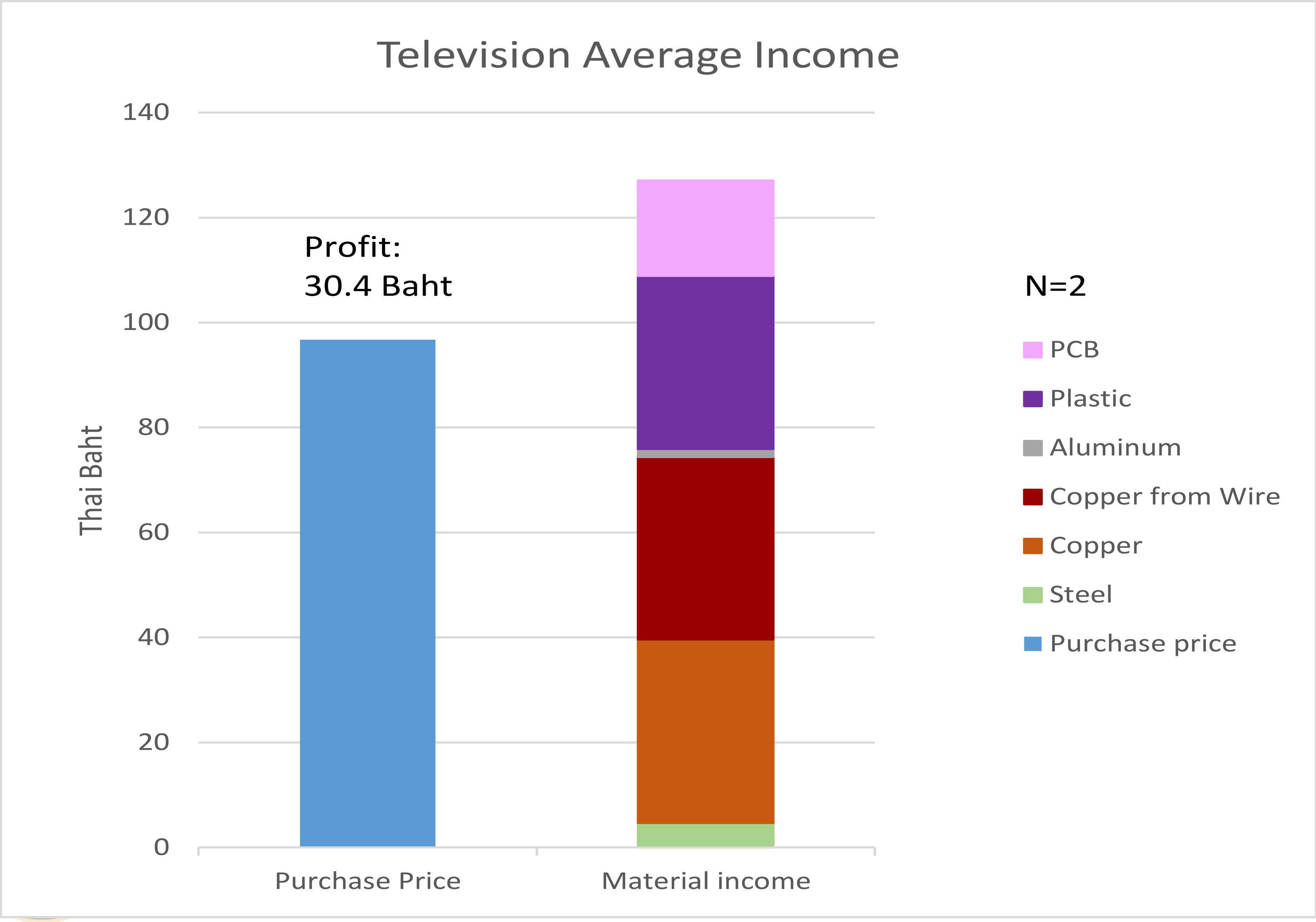


Mass decomposition: TV example

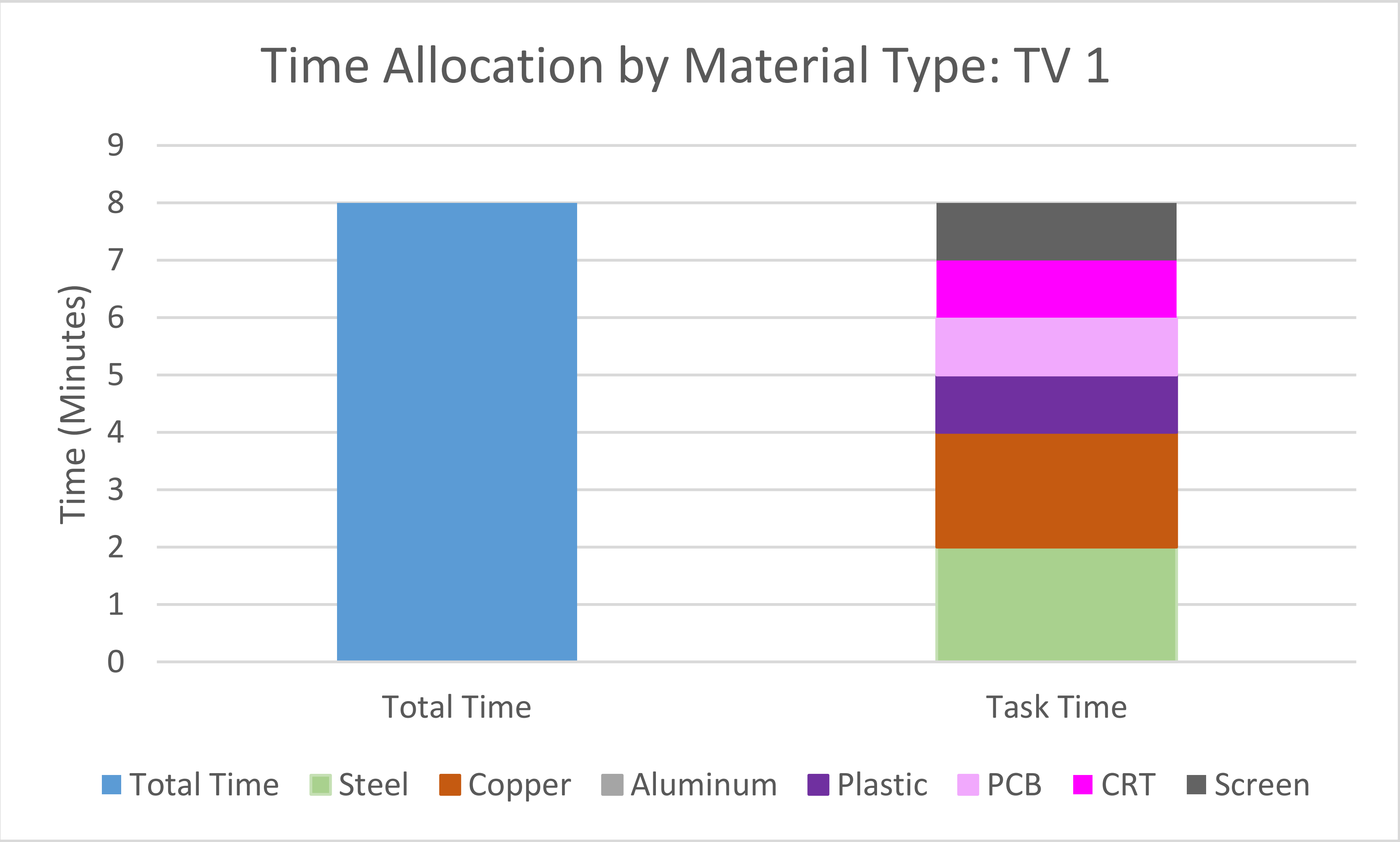


Socio-economic assessment

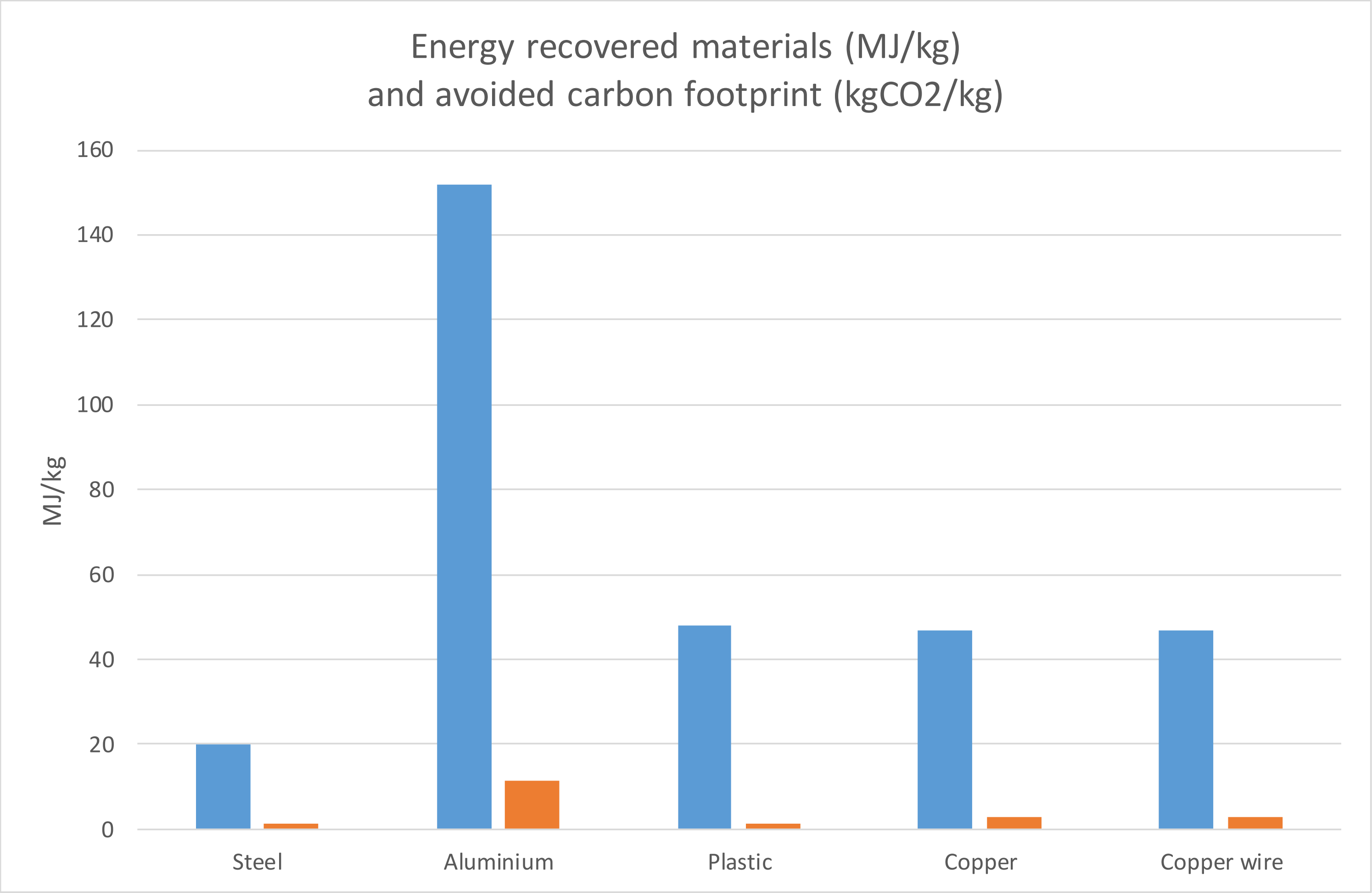
Average income television



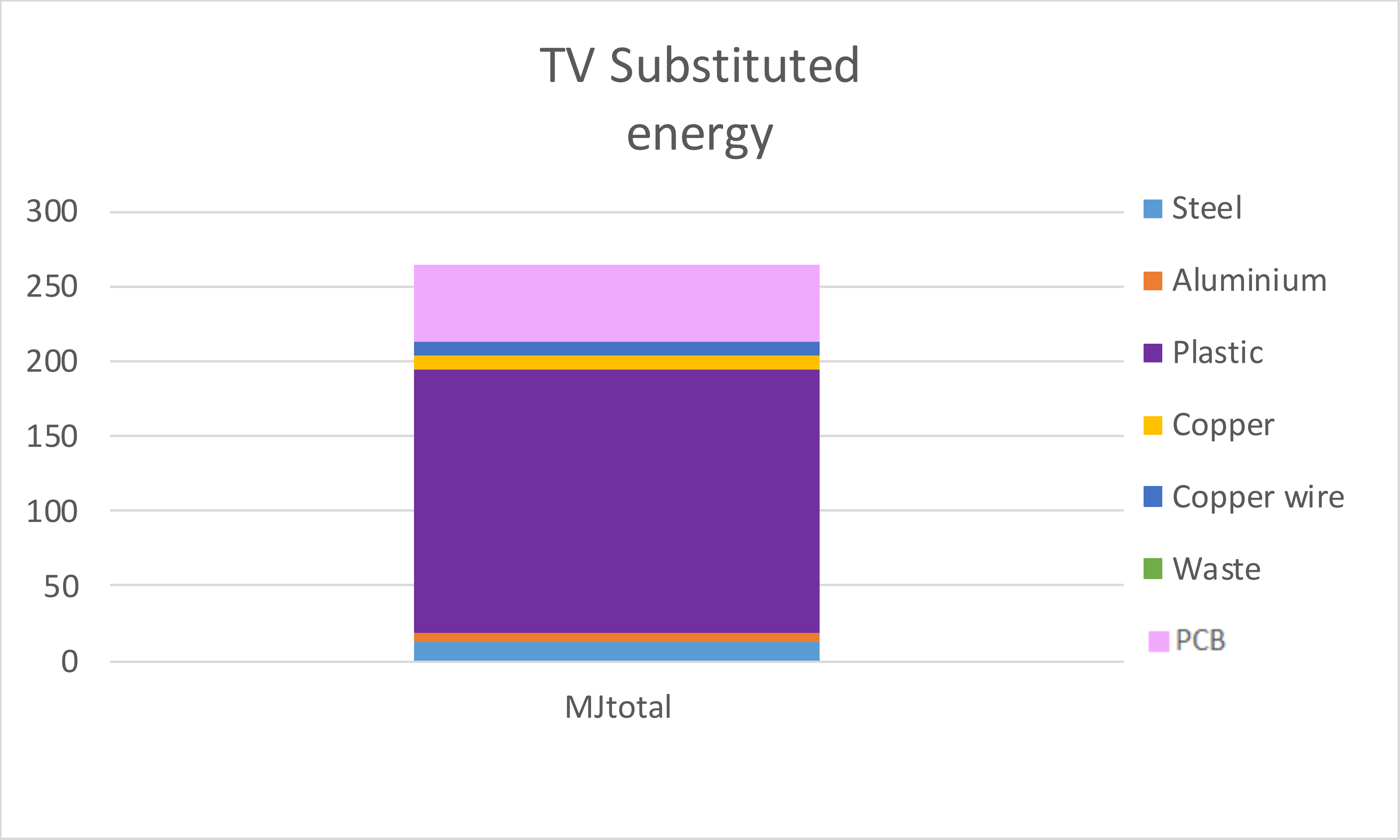
Socio-economic and injury risks



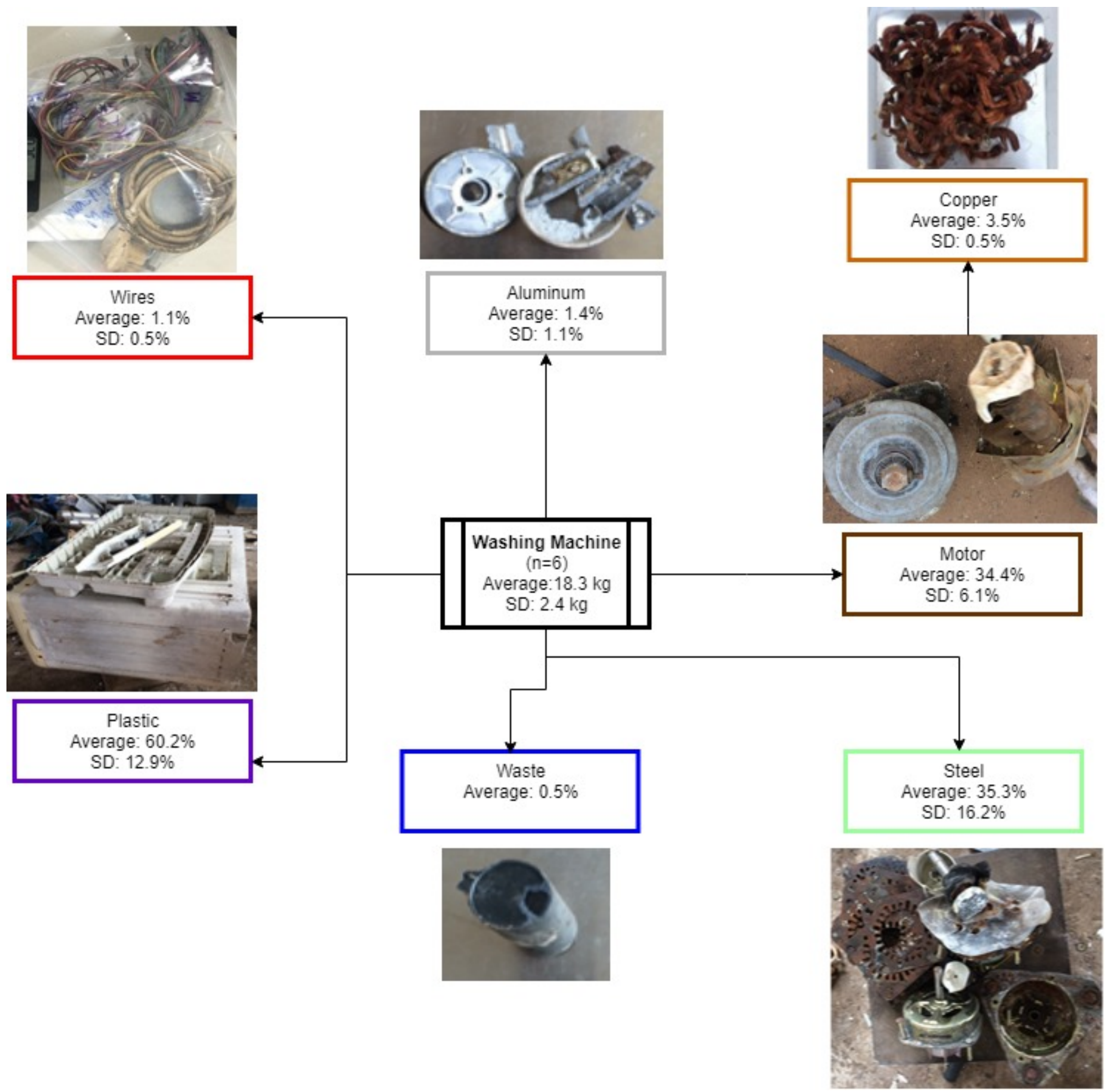
Energy recuperated avoided CO2 per kg



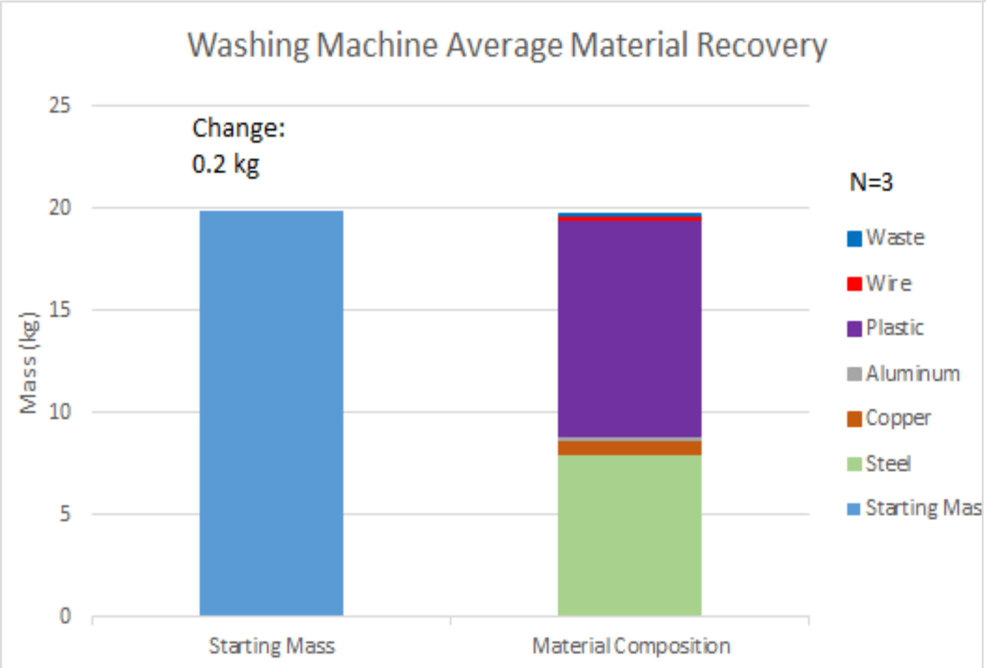
Average avoided and CO2 Television

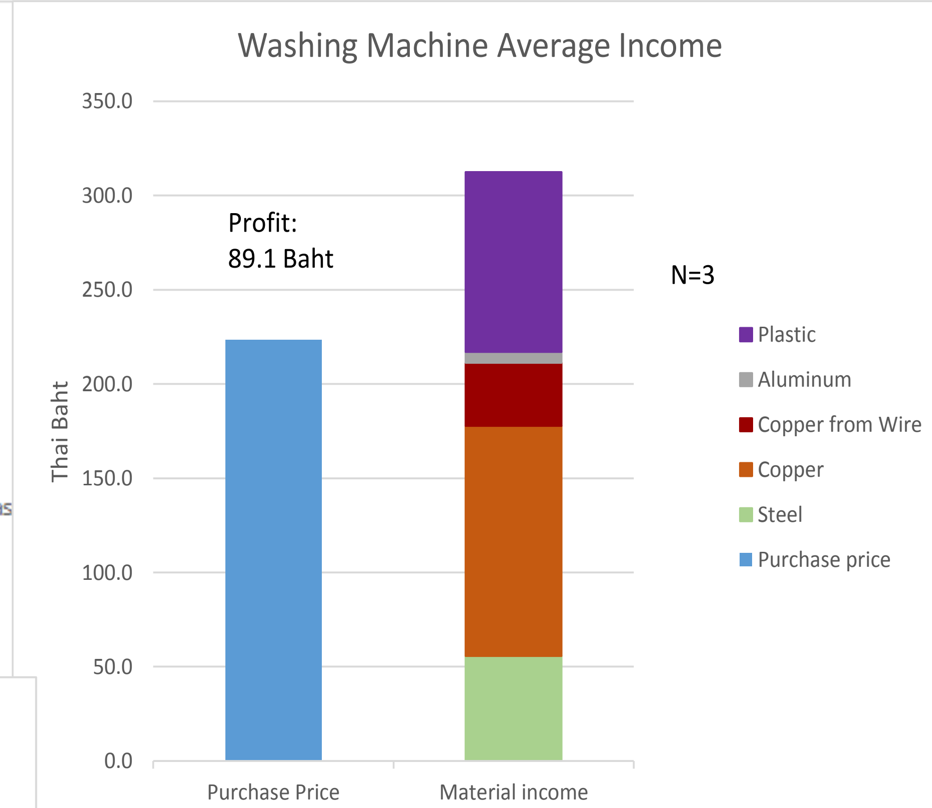


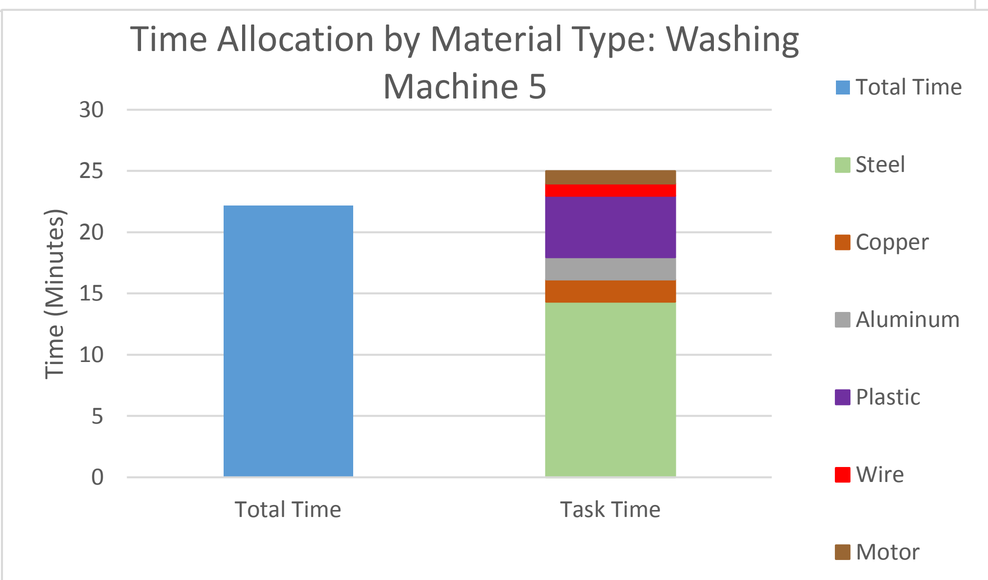
Washing machine recycling

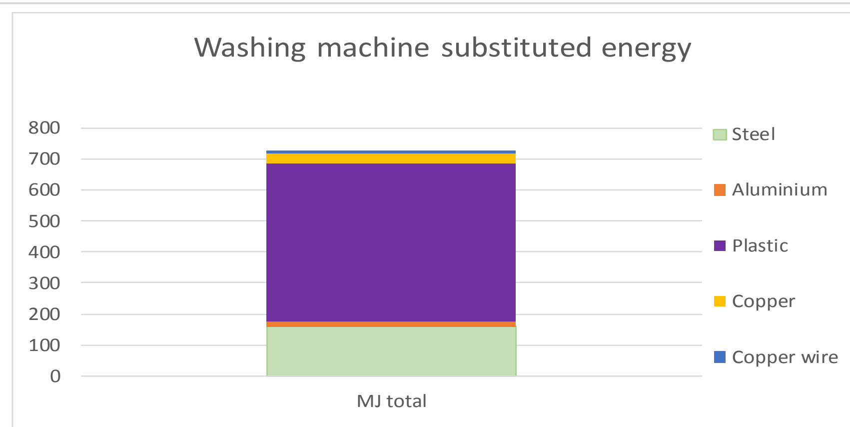


Washing machine recycling









Matrx approach for combining LCA and Mass Flow analysis

				Steel	Aluminium	Plastic	Copper	Copper wi	Waste	PCB	Screen	Compressor	Total
		Income	**Baht/week**	**2329**	**1542**	**3321**	**6636**	**3670**	**0**	**818**	**0**	**0**	**18316**
		Price	Baht/kg	7	48	9	175	175	0	16	0	0	
Item	Piece/week	Weight/piece	kg/week	Steel	Aluminium	Plastic	Copper	Copper wi	Waste	PCB	Screen	Compressor	
Fan	100	2.4	241.6	49.8%	9.2%	28.7%	6.4%	2.4%	3.5%	0.0%	0.0%	0.0%	
Refrigerator	7	28.8	201.4	51.1%	3.6%	14.3%	3.2%	2.1%	11.8%	0.0%	0.0%	13.9%	
Washing machine	10	19.7	196.6	40.5%	0.6%	53.9%	3.5%	1.0%	0.4%	0.0%	0.0%	0.0%	
TV	45	20.9	942.5	3.2%	0.2%	17.5%	1.0%	0.9%	20.1%	5.4%	51.7%	0.0%	
				Steel	Aluminium	Plastic	Copper	Copper wi	Waste	PCB	Screen	Compressor	Total
		Avoided energy	MJ/kg	19.98	152	48	46.75	46.75					
		Total avoided en	**MJ/week**	**6648**	**4882**	**17710**	**1773**	**981**	**0**	**0**	**0**	**0**	**31994**

Next steps: Complement by combining time per task with risks of injury/hour

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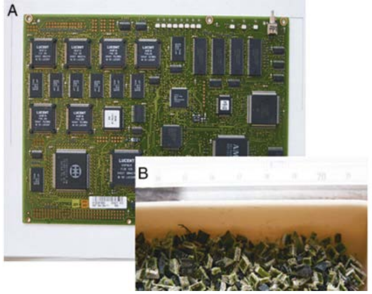


Short communication

Heavy metal partitioning from electronic scrap during thermal End-of-Life treatment

Wolfram Scharnhorst [a,b,*], Christian Ludwig [a,c], Jörg Wochele [a,c], Olivier Jolliet [a,d]

Table 3
Experiment conditions (N.D. = not detected), volatilisation of heavy metals during thermal treatment in the QTR and initial metal masses in the PWBA samples

Elements	Element masses initial [g]				Element masses residual [g]				Volatilisation [%]			
	S1 [550ox]	S2 [550red]	S3 [880ox]	S4 [880red]	S1 [550ox]	S2 [550red]	S3 [880ox]	S4 [880red]	S1 [550ox]	S2 [550red]	S3 [880ox]	S4 [880red]
As	0.00025	0.00025	0.00026	0.00026	0.00	0.00	0.00	0.00	100	100	100	100
Cd	0.00001	0.00001	0.00001	0.00001	0.00	0.00	0.00	0.00	100	100	100	100
Ga (aqua regia)	0.00006	0.00006	0.00006	0.00006	0.00	0.00	0.00	0.00	*	*	*	*
Ga (HF)	0.817	0.826	0.857	0.832								
Ni	0.152	0.149	0.157	0.156	0.15	0.15	0.15	0.16	0.70	1.19	6.81	0.36
Pb	0.070	0.068	0.072	0.071	0.03	0.06	N.D.	0.02	55	11	N.D.	72
Sb	5.813	5.694	6.003	5.949	0.09	0.17	0.18	0.23	99	97	97	96

The error of the measurement is in the range of 5–10%. *: The achieved results are presented and discussed in detail directly in the text.

Conclusions

Developed a life cycle based tool that enables to evaluate the socio-economic, occupational and environmental risks and benefits associated with multiple electronic products

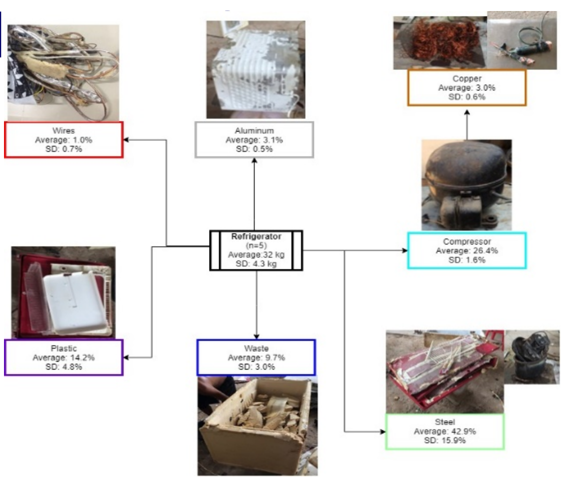
→ **Combines environmental and socio-economics consistently**

→ **Combines occupational and environmental**

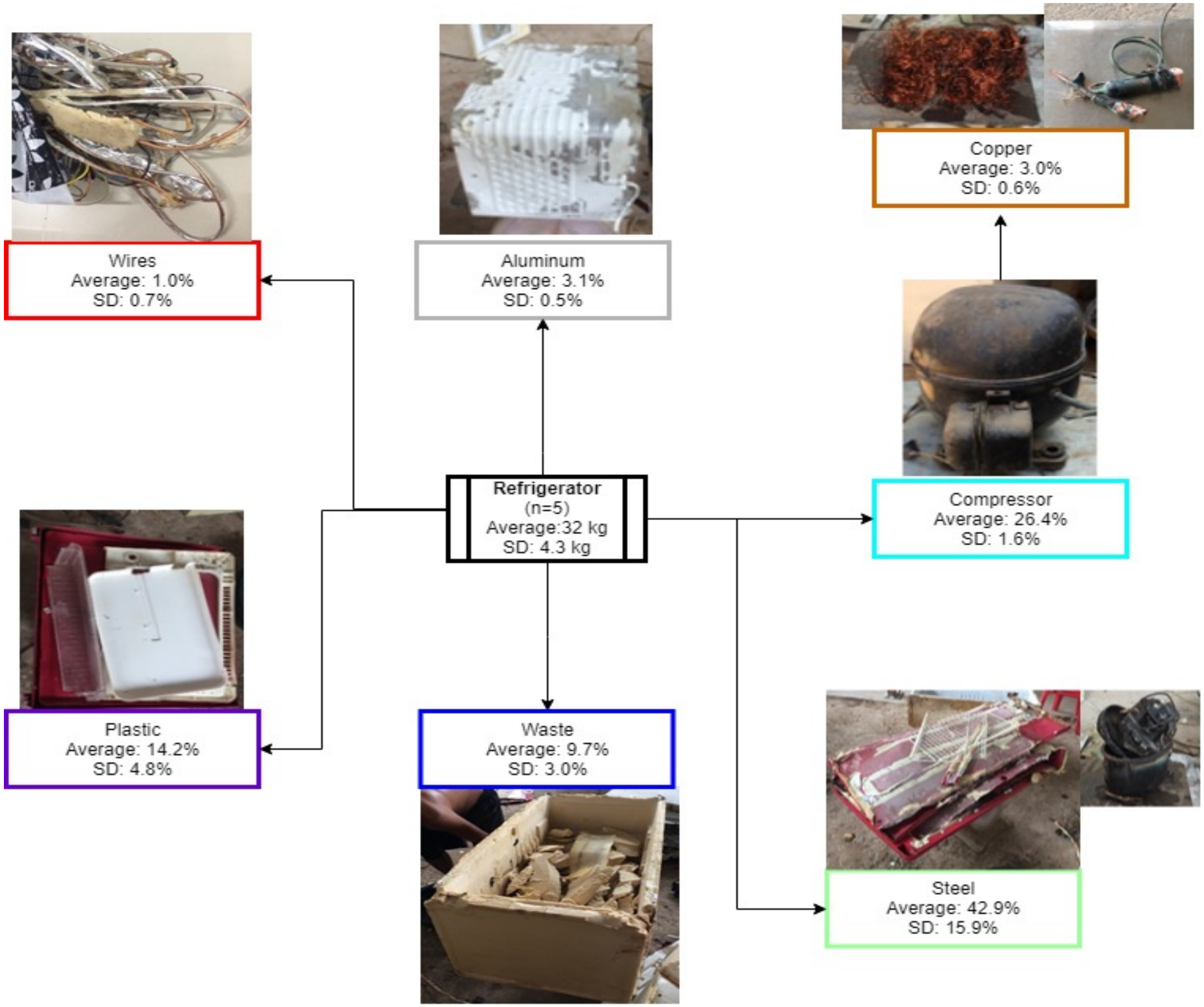
→ **Possible to apply the approach at prod at regional levels (LCA and MFA)**

→ **Mitigate risks, while maintaining economic and environmental benefits**

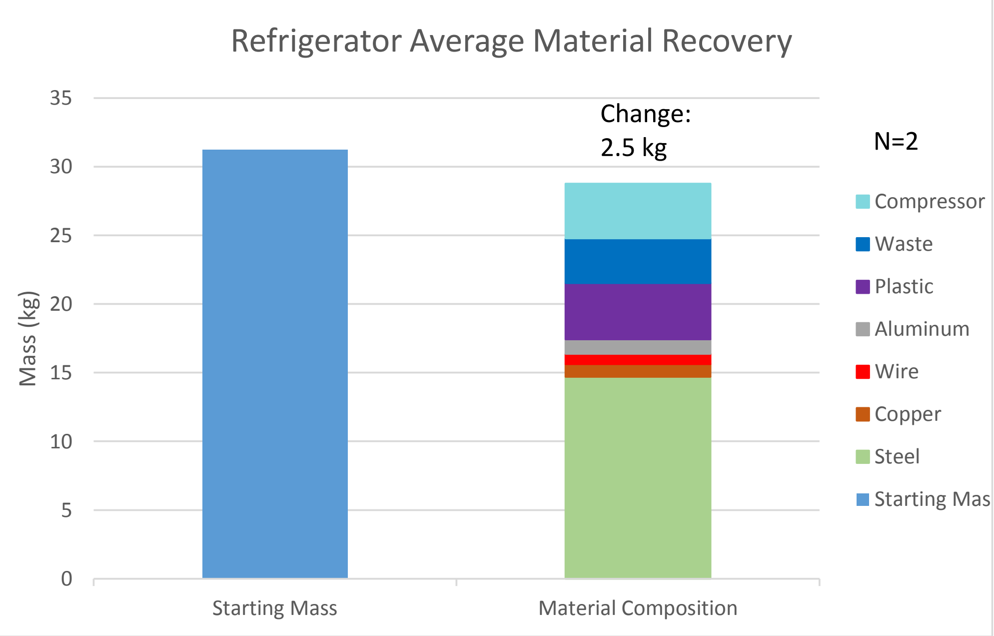
→ **Let us play … but also use it**

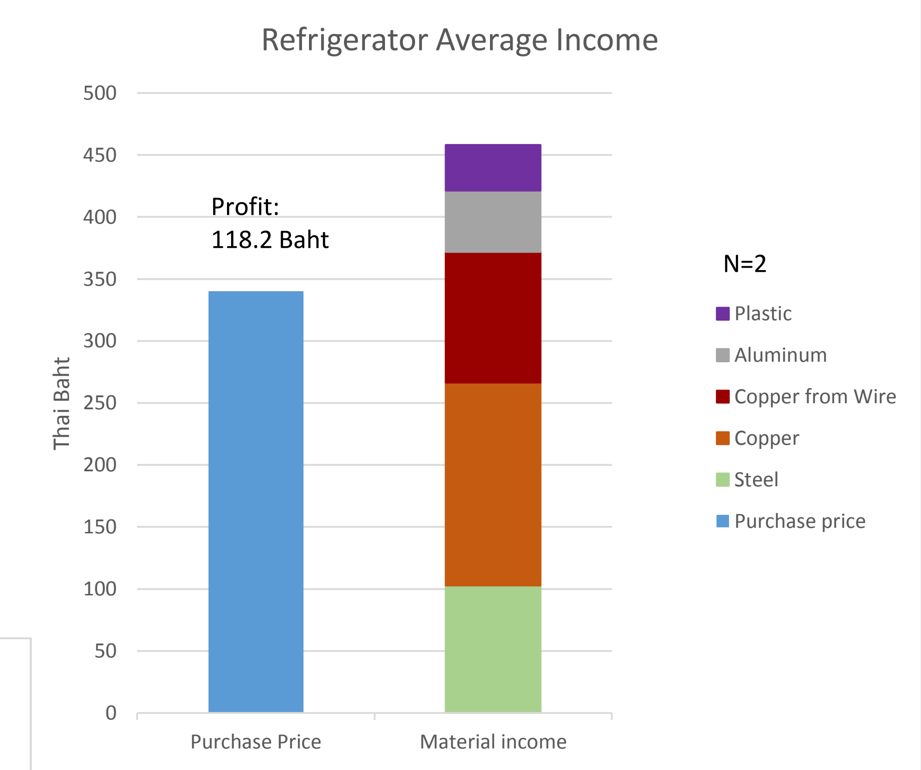


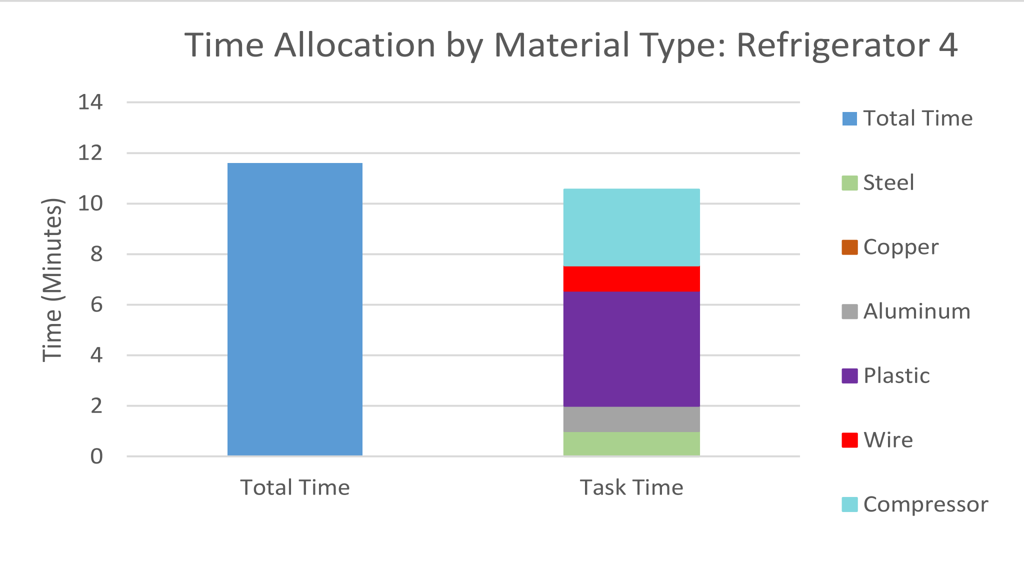
Refrigerator recycling



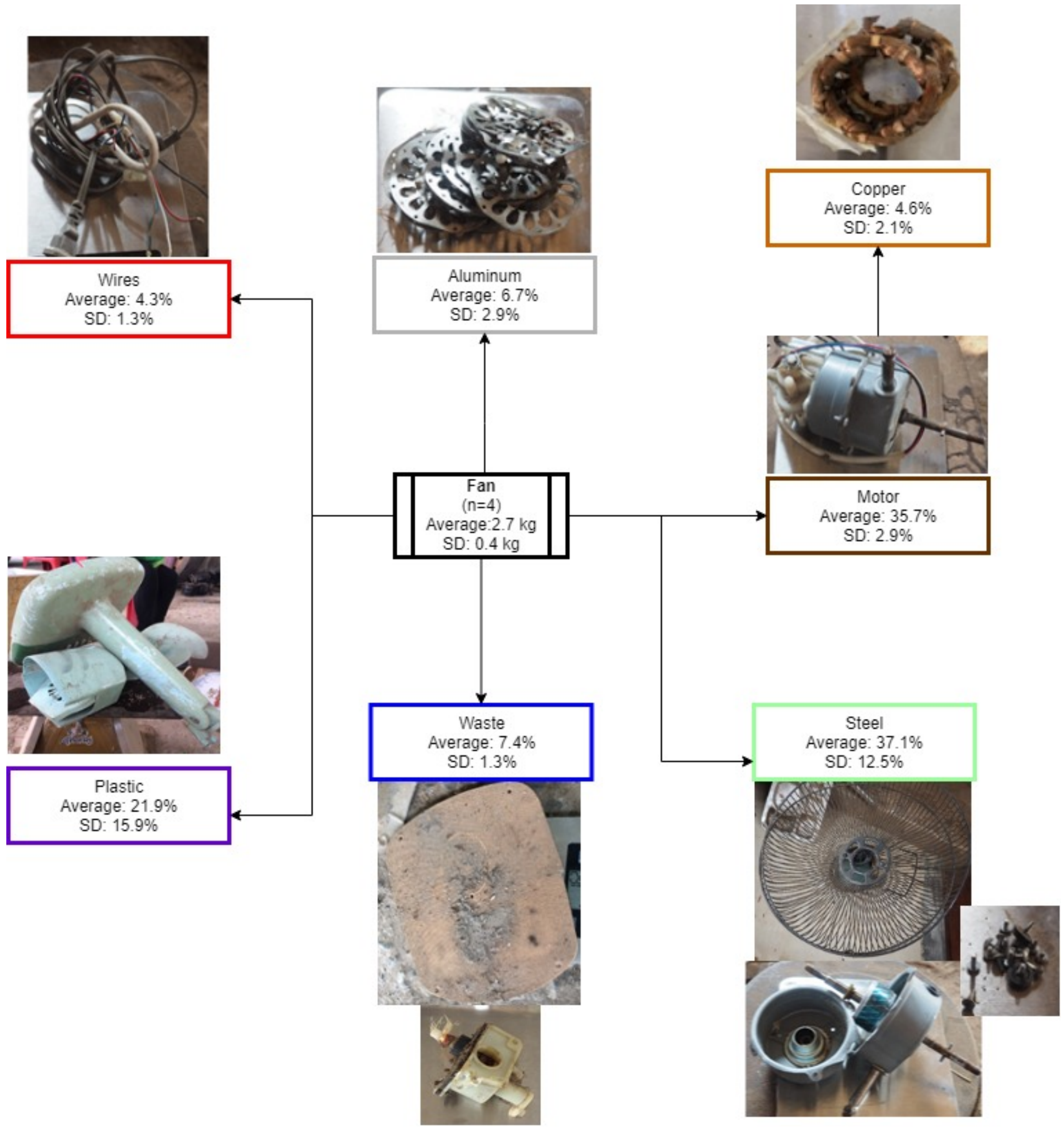
Refrigerator recycling



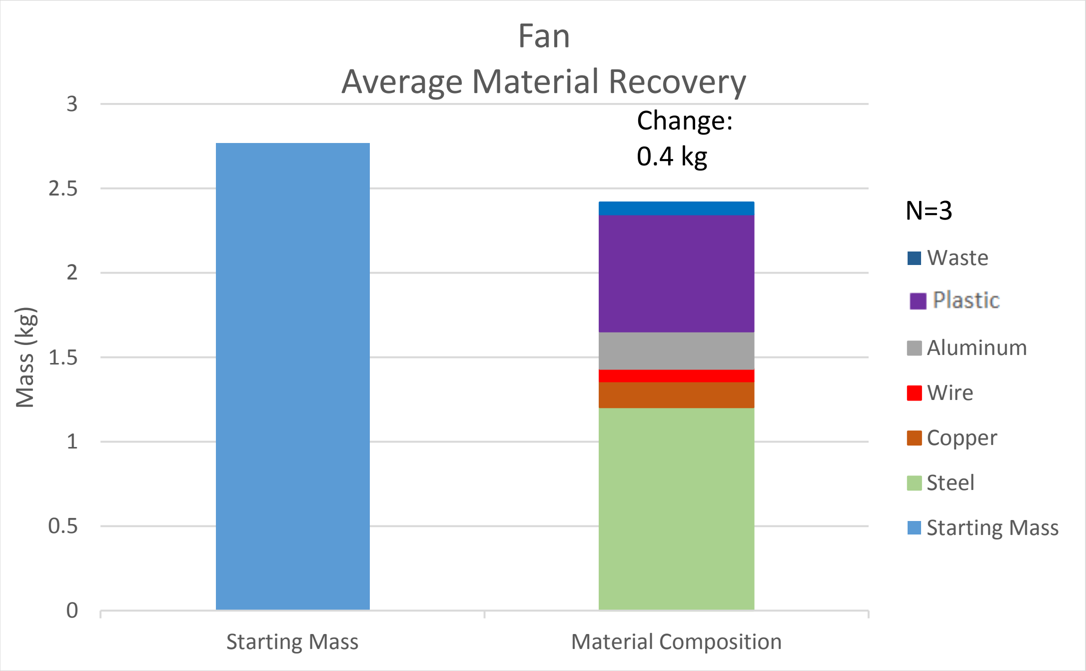


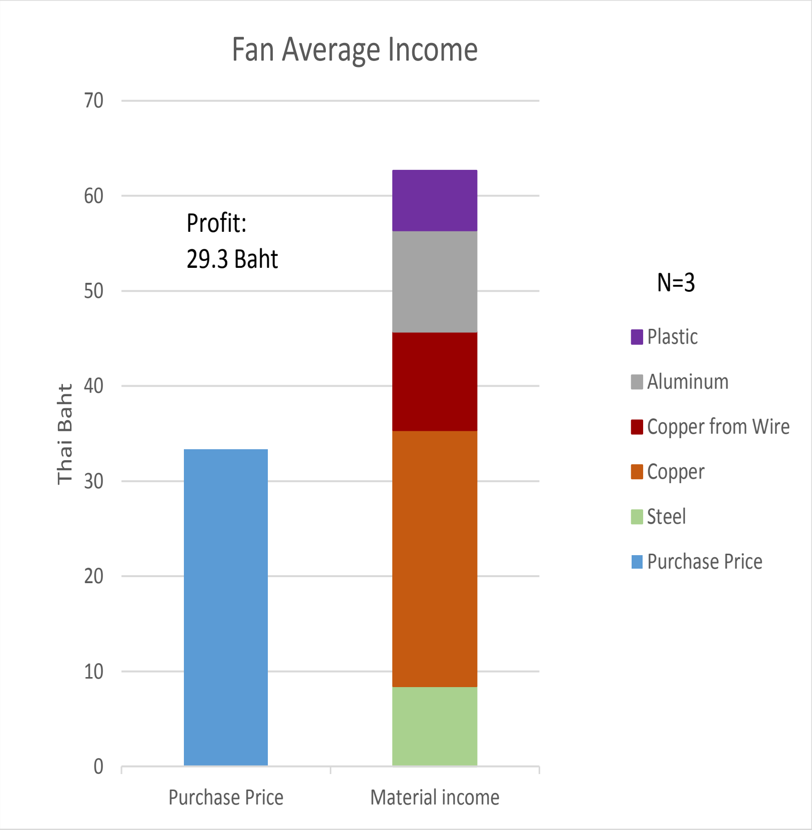


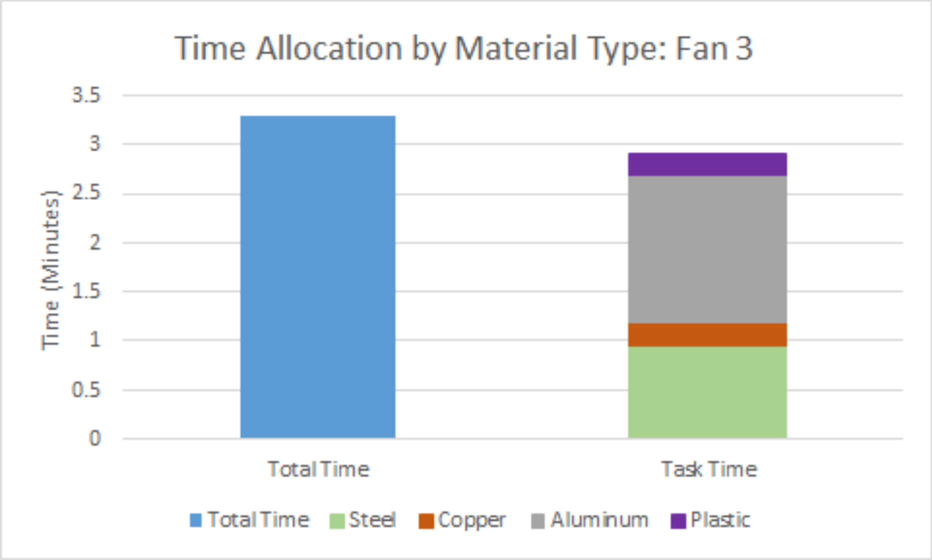
Fan recycling



Fan recycling







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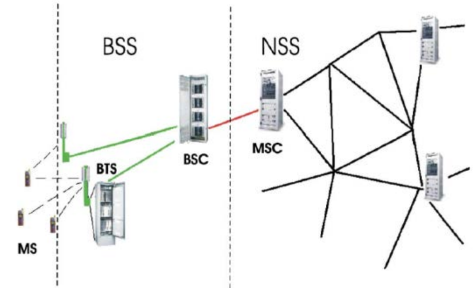


The end of life treatment of second generation mobile phone networks: Strategies to reduce the environmental impact

Wolfram Scharnhorst[a,b,*], Hans-Jörg Althaus[a], Mischa Classen[a], Olivier Jolliet[b], Lorenz M. Hilty[a]

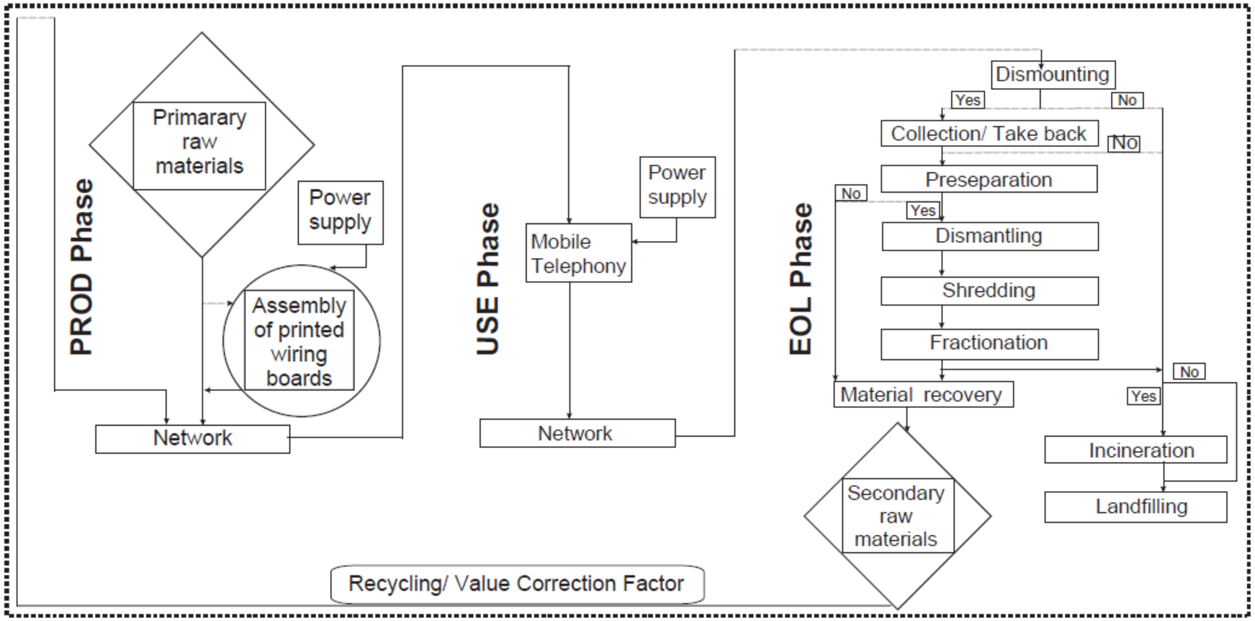
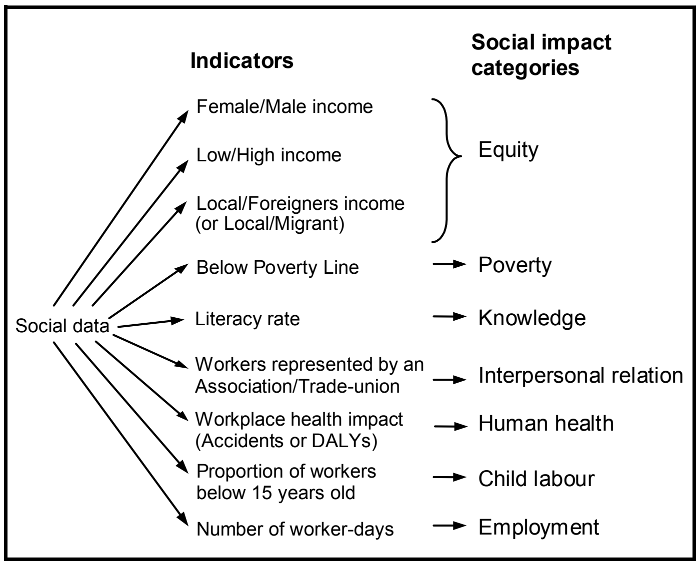
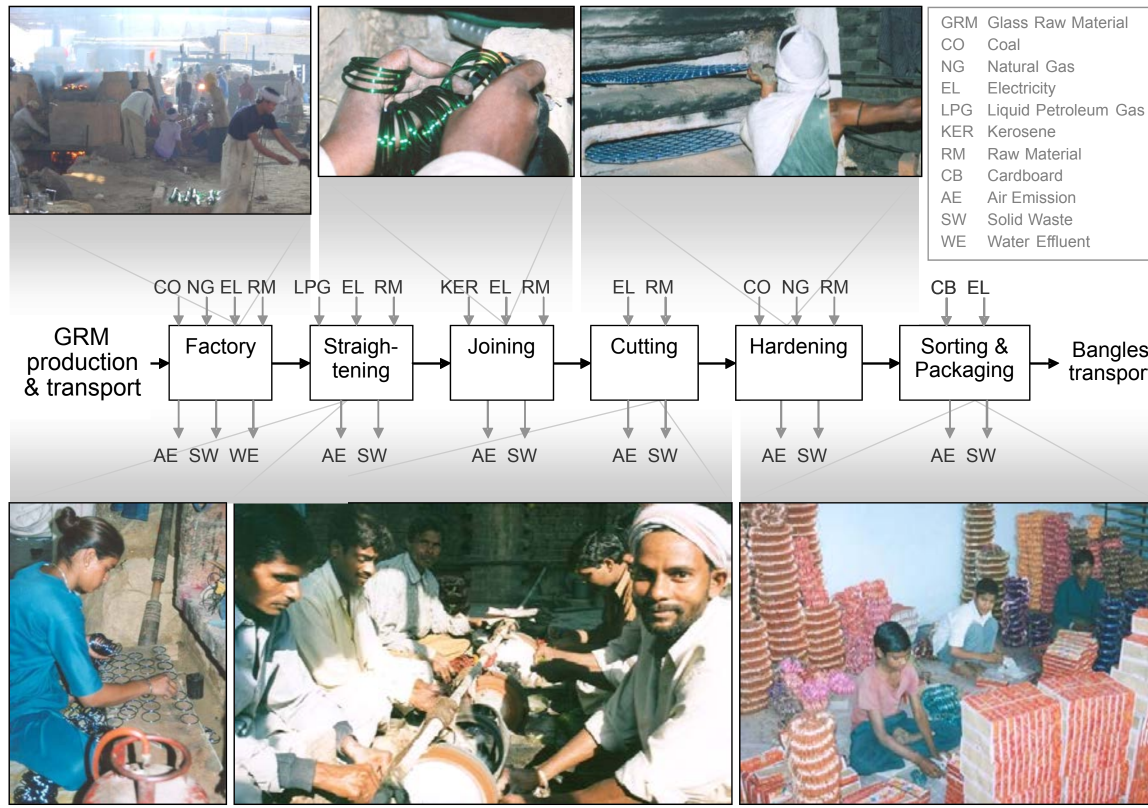


Fig. 1. Flow chart and system boundaries of the life cycle phases of the mobile phone network studied.

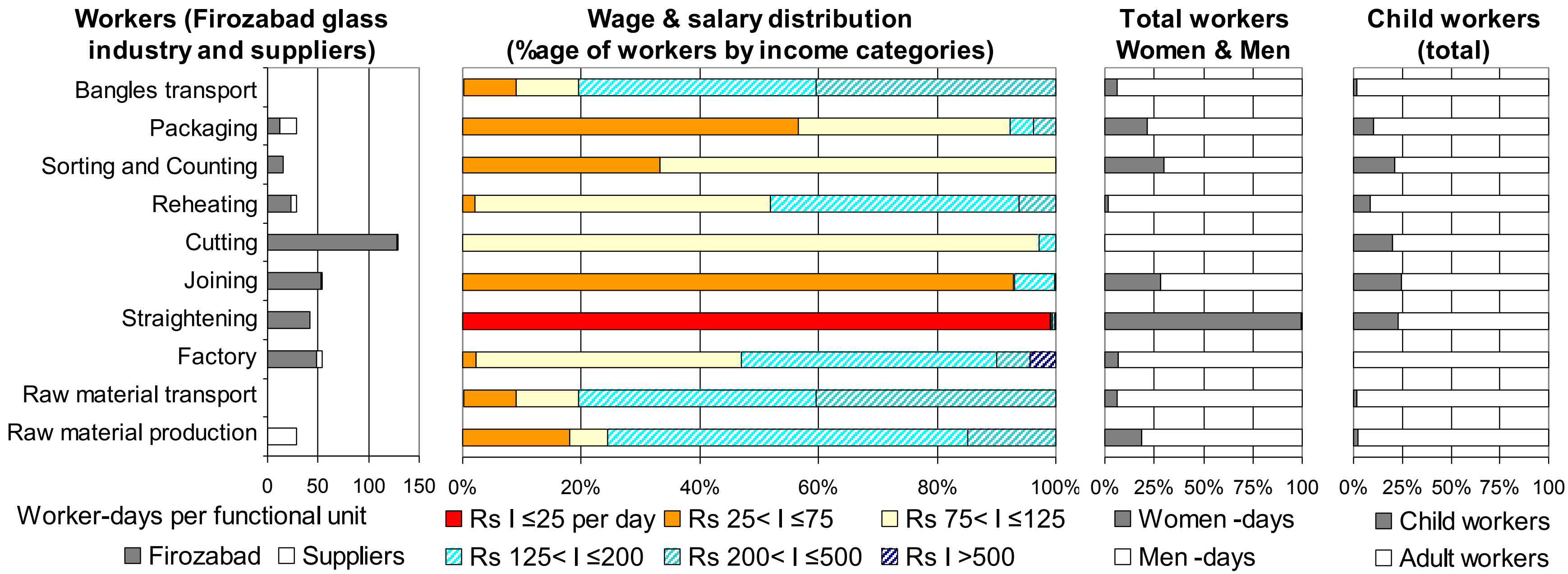
Related UM work





Roquier and Jolliet, Social Life Cycle

Related UM work



Roquier and Jolliet, Social Life Cycle