

# WEEE RECYCLING ECONOMICS

The shortcomings of the  
current business model

Commissioned by EERA

Conducted by United Nations University, UNU - VIE SCYCLE  
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## INTRODUCTION

The EU WEEE Directive entered into force in 2003 and in 2015 approximately one-third of the total volume of electrical and electronic equipment (EEE), that was put on the market (POM), was reported as collected and treated in compliance with this Directive.

Various factors affect the functioning of the regulated market of WEEE collection and treatment, in particular:

1. The positive intrinsic value of certain WEEE products/components,
2. The volatility of the commodity prices resulting from the treatment,

3. The costs arising with the compliance of legal requirements in logistics, depollution and labour, and
4. The widespread selective "scavenging" of products, components and materials, which hinders overall quality in treatment.

Some factors are dependent on dynamics not under control of the recycling industry or players involved in the end-of-life phase (like the market value of commodities or the material composition of products), while others are directly linked with the compliance with legal requirements and distortions happening on the market.

## VARIOUS COST COMPONENTS FOR TREATMENT OF WEEE



## COSTS OF RECYCLING

Understanding of economics of recycling cannot be decoupled from understanding the cost structure of companies and various cost components:

- **CAPITAL COSTS:**  
All assets related to the processing of waste (buildings, machines, equipment, patents, etc.);
- **TECHNICAL COSTS, DIVIDED INTO:**
  - **Office, Administrative and Overhead:** all costs related to personnel not directly working in production;

- **Operational Costs - basics:** all costs related to depollution, processing, proper waste disposal, etc;
- **Operational Costs - quality & service:** all costs related to quality, waste characterization, proper reporting, and compliance with best available technology - BAT and standards, etc.

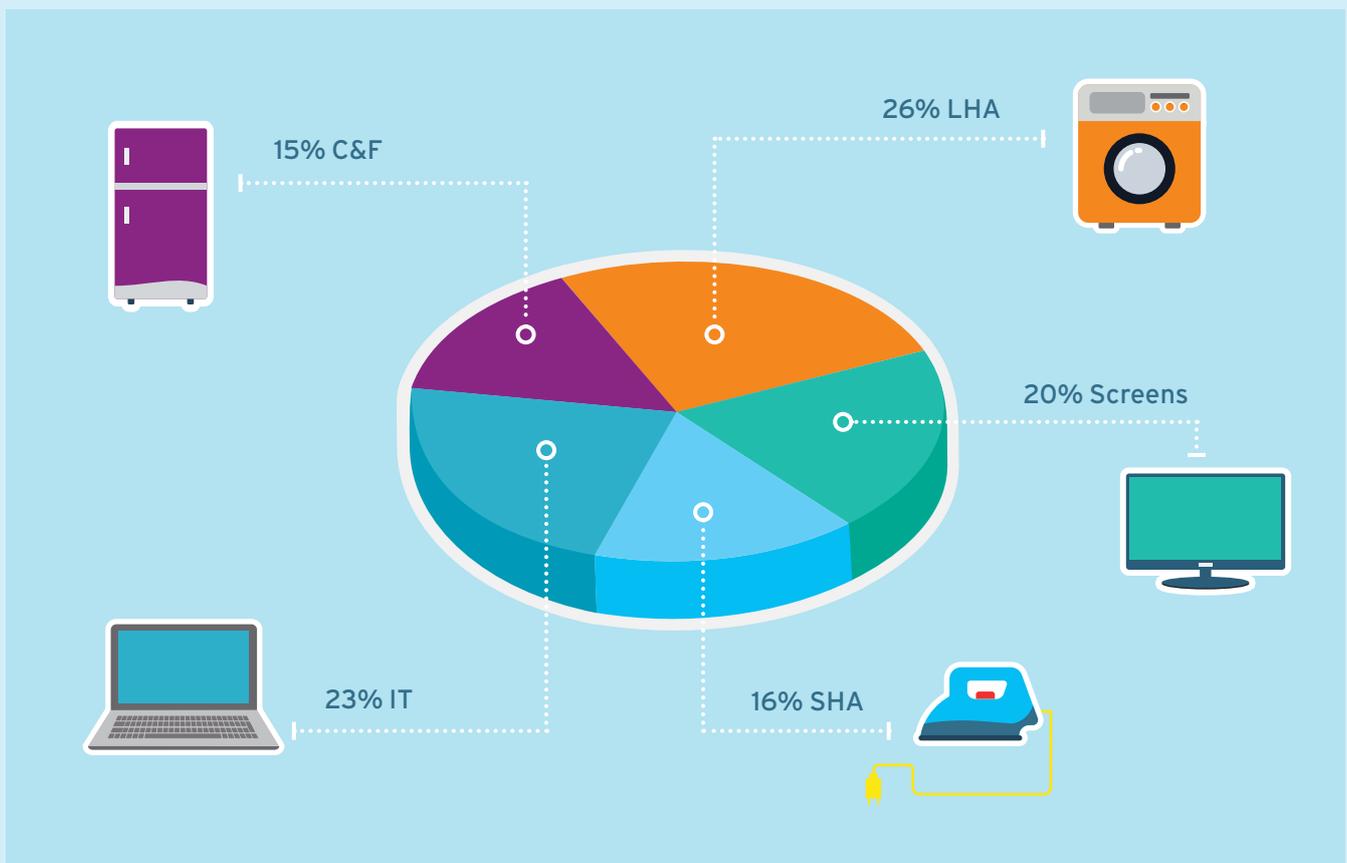
The study includes the Operational Costs - basics and Operational Costs - quality & service. Other costs components such as capital costs and office, administrative and overhead costs are not considered in this study.

## SCAVENGING: ENVIRONMENTAL AND ECONOMIC CONSEQUENCES FOR SOCIETY

13 EERA Members, encompassing 27 treatment locations in 13 countries for a total volume reported of 465,000 tons, provided data over 2016. The reported volume concerned various collection categories; for Cooling and Freezing (C&F) there were 6 responses, for Screens 10, Lamps 3 (further excluded), Large Household (LHA) 9, Small Household (SHA) 12 and IT equipment 11.

Two main elements were investigated:

- the scavenging of whole products, particularly those having higher economic value or re-use potential, which are not ending up in the official take-back systems set-up by producers and importers, and
- scavenging of components, which has environmental and economic consequences.



THE PERCENTAGE OF PRODUCT CATEGORIES IN THE STUDY

## SCAVENGING OF WHOLE PRODUCTS

Often products discarded by consumers are scavenged, particularly in collection categories Screens, Cooling and Freezing and IT because:

- the economic value of some components in the products discarded (e.g. compressors, cables containing copper, printed circuit boards,...) or
- the potential revenues that can be obtained when re-selling products abroad for re-use purposes, mostly illegally traded, or

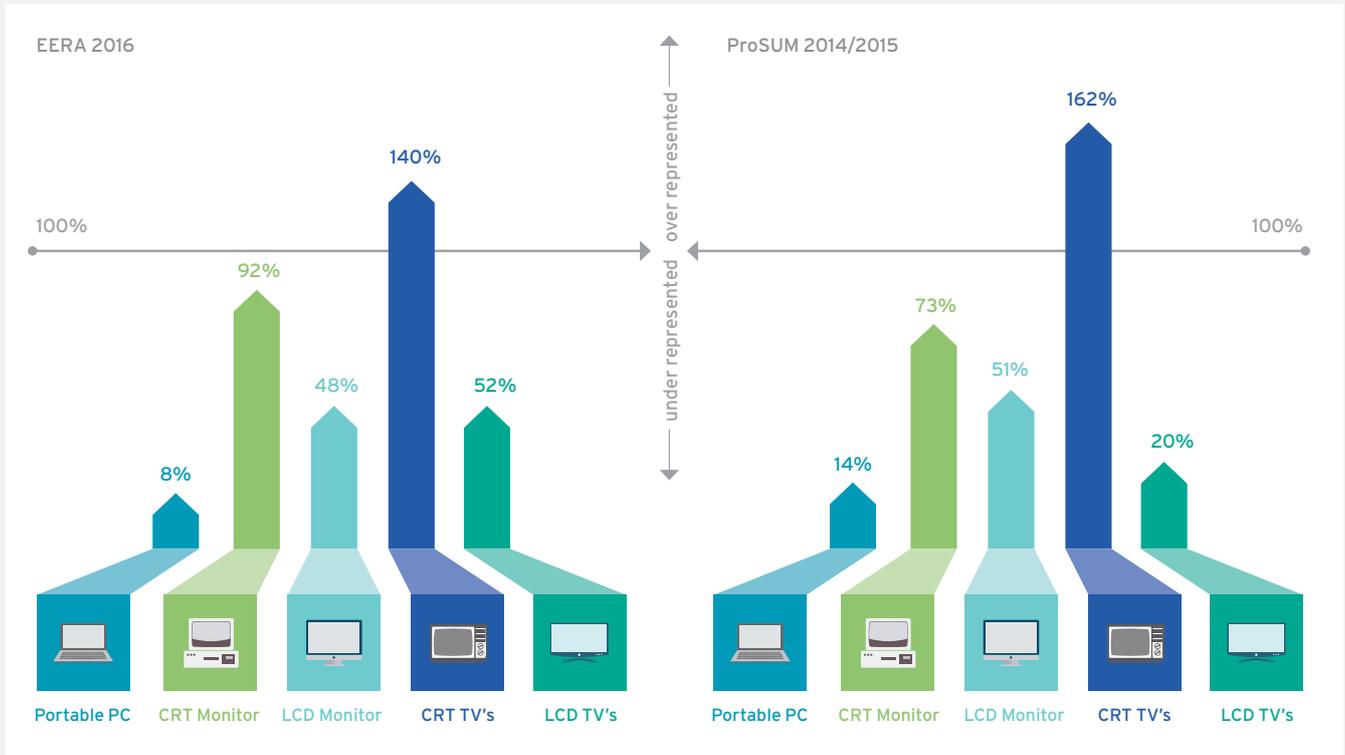
- the treatment is cheaper in countries where compliance with EU WEEE legislation is not required or not enforced.

Despite differences in collection categories and the way products are actually collected\* in Europe, an indicative analysis on the relative presence of products in the return stream was made.

\* *f.i. laptops often appear in both the Screens and IT category, irrespective of the official collection category they are allocated.*

Due to the trade in laptops and tablets and (to a lesser extent) LCD TV's, as well as the lack of other outlets for relatively less valuable CRT's, the actual presence of valuable products is significantly lower in the officially reported collection channels and the share of CRT TV's is higher.

Laptops (10%-20%) and LCD Monitors and TV's (20%-40%) are significantly under-represented in the reported collection volumes. The results in this study are comparable to those of the ProSUM project. [www.prosumproject.eu](http://www.prosumproject.eu)

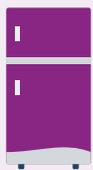


PRODUCTS RECEIVED AT TREATMENT PLANTS AS PERCENTAGE OF WEEE GENERATED VOLUMES (= 100 %).

## SCAVENGING OF COMPONENTS

In addition to scavenging of whole products, at collection points or during the steps prior to the hand-over to a recycling plant, components and materials with a high value are removed. This has both environmental and economic consequences, but also a societal impact that undermines the reasoning behind the WEEE Directive

and the Circular Economy package (increase the level of environmental protection and the recovery of material to feed the EU economy). The economic consequences under the current business model, adopted by the producers' compliance schemes in Europe, have a direct impact on the profitability of recyclers.

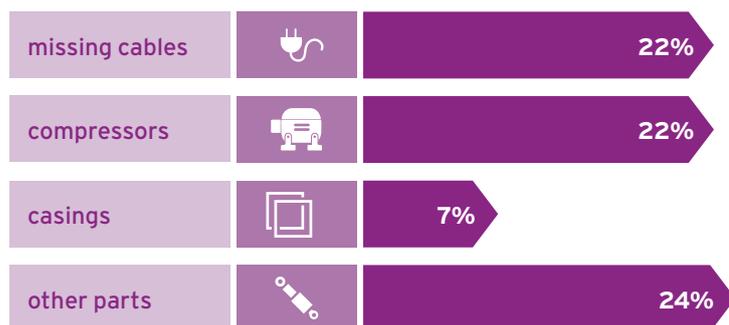


### SCAVENGING OF COOLING AND FREEZING

2016 data based on 58.000 tons, 17 locations.

Note: Only 48% of C&F generated is reported as collected in EU

#### Scavenging level



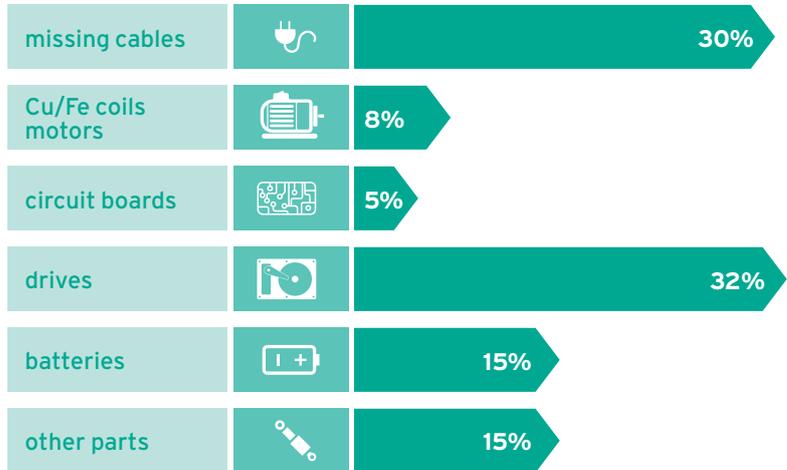
### SCAVENGING OF SCREENS



2016 data based on 77.000 tons, 20 locations.

Note: 66% of the treated screens in EU are still CRT's

#### Scavenging level

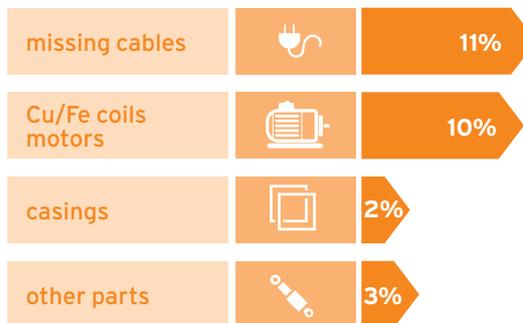


### SCAVENGING OF LARGE HOUSEHOLD

2016 data based on 100.000 tons, 20 locations.

Note: Only 32% of LH generated is reported as collected in EU.

#### Scavenging level



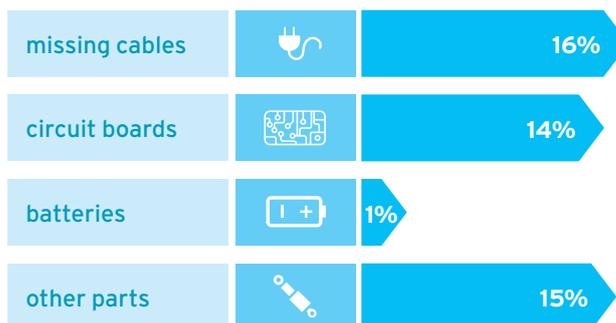
### SCAVENGING OF SMALL HOUSEHOLD INCLUDING IT



2016 data based on 63.000 tons, 12 locations.

Note: 6% of the treated SH at recyclers consist of laptops, tablets, mobile phones and game consoles.

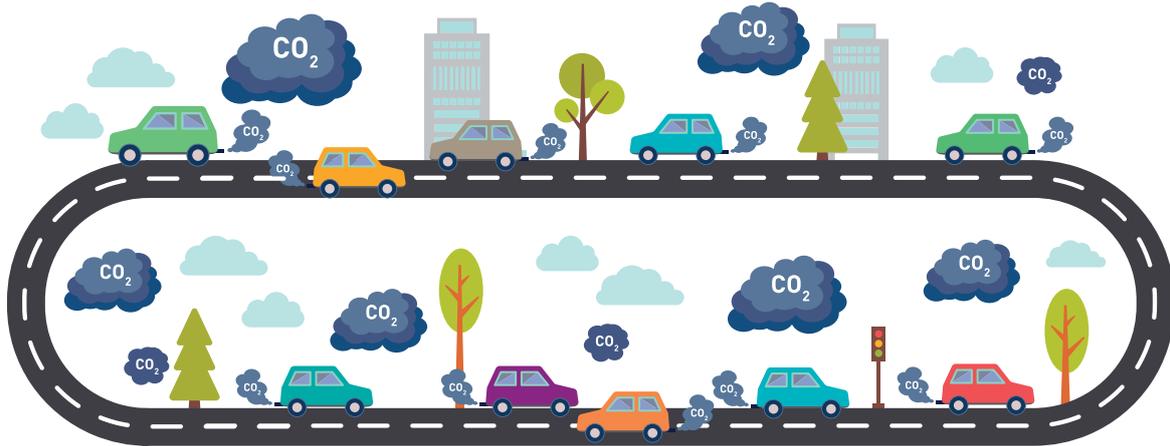
#### Scavenging level



From an environmental perspective, both product and component scavenging of C&F (especially compressors) are alarming, due to the release of the ozone depleting substances (CFC's) contained in the refrigeration circuit. The product scavenging is 48%.

On top of that the scavenging of compressors averages 22%. When extrapolating the figures derived from the quantities handled in this study to entire EU volumes, based on 1.7 million tonnes of WEEE generated, it equals **8 million tonnes of CO<sub>2</sub> equivalent per year**.

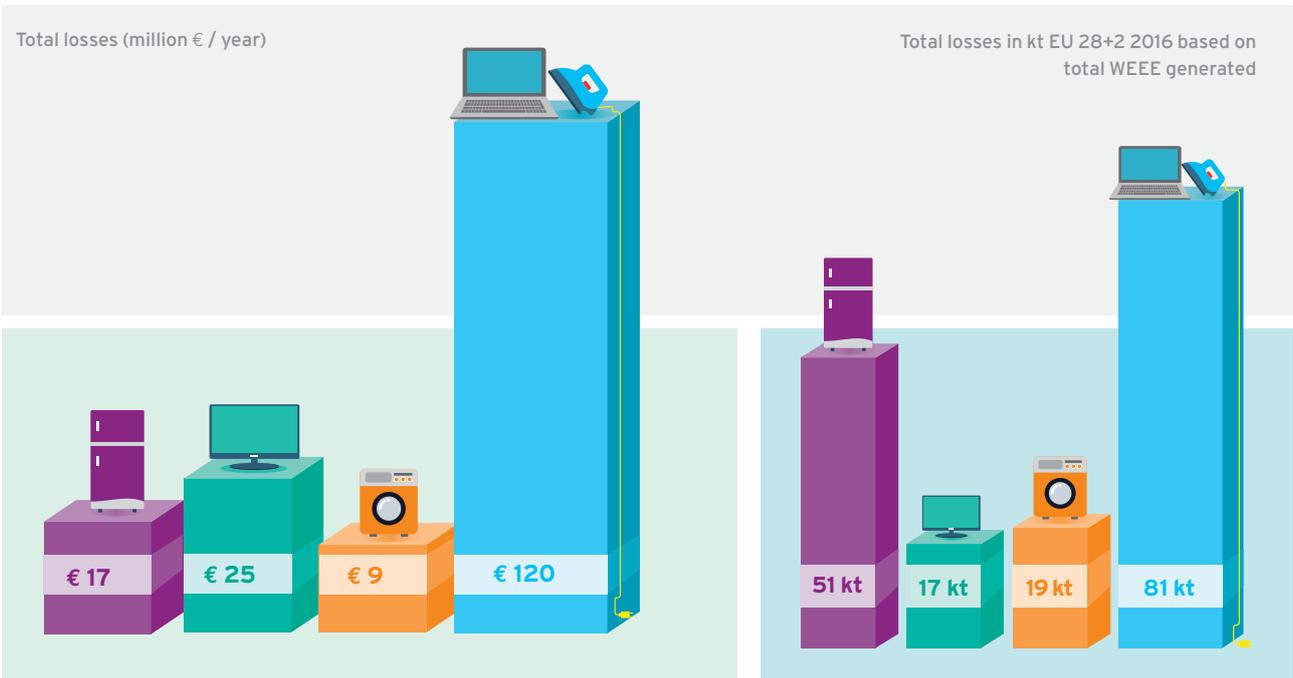
SCAVENGING OF C&F RESULTS IN AN UNNECESSARY EMISSION OF 8 MILLION TONNES OF CO<sub>2</sub> EQUIVALENT PER YEAR WHICH EQUALS THE ANNUAL EMISSIONS OF 6 MILLION CARS.



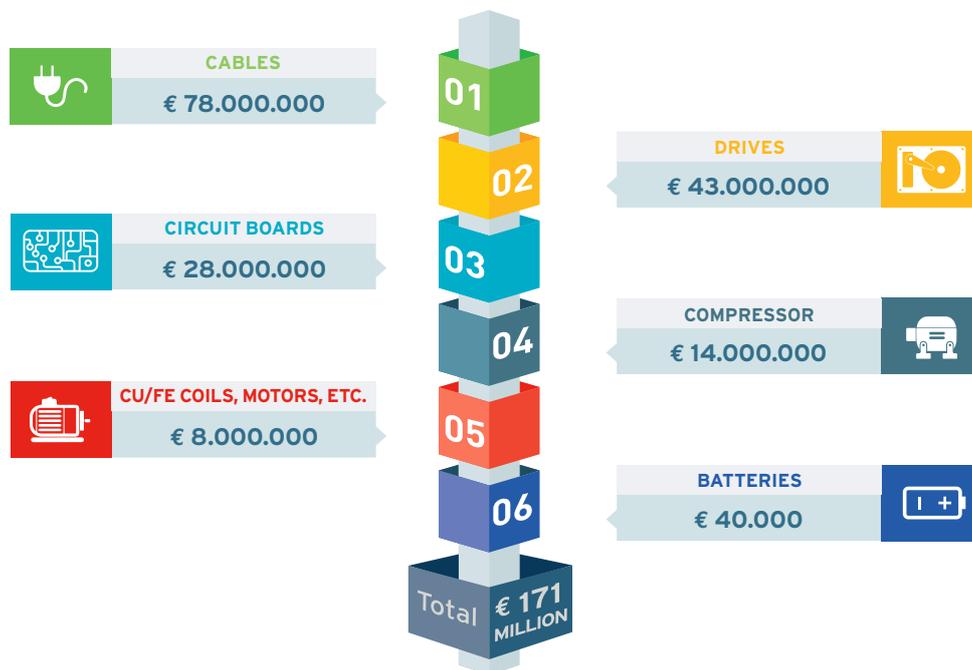
From an economic point of view, when considering the total WEEE Generated in EU28 (+ Norway and Switzerland), the estimated losses related to

components for the year 2016 amount to about € 171 million of diverted material value.

ESTIMATED LOSSES (IN EURO AND KILOTONNES PER YEAR) RELATED TO SCAVENGING OF COMPONENTS FOR C&F, SCREENS, LHA AND SHA+IT



## VALUE (IN MILLIONS €) OF SCAVENGED COMPONENTS IN 2016



## THE IMPACT OF NON-COMPLIANT RECYCLING

The analyses of the recycling costs makes it possible to describe the “minimum technical cost” for compliant recycling and the quantification of the “unfair savings and cost benefits” in case of non-compliance. The analyses consist the following elements:

#1



Costs related to treatment  
(shredding, material separation)

#2



Costs related to de-pollution

#3



Costs related to disposal of hazardous fractions from de-pollution activities (Annex VII requirements)

#4



Costs related to disposal of non-hazardous fractions derived from treatment operations

#5



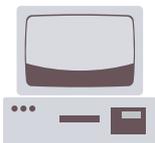
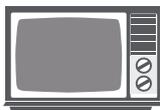
Costs related to proof of legal compliance, quality and service level (f.i. waste classification, control by and reporting to authorities/compliance schemes), and implementation of standards

## COMPOSITION OF COSTS FOR COMPLIANT RECYCLING OF WEEE PRODUCT CATEGORIES



### COOLING AND FREEZING

€ / Metric tonne (MT)



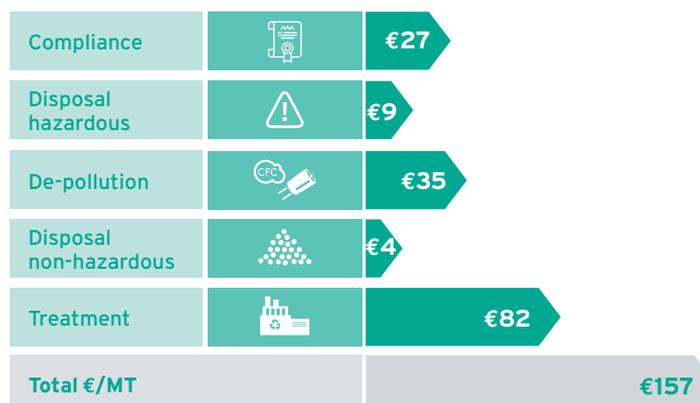
### CRT TV/MONITOR

€ / Metric tonne (MT)



### FLAT PANEL DISPLAYS

€ / Metric tonne (MT)





### LARGE HOUSEHOLD

€ / Metric tonne (MT)

Compliance		€42
De-pollution		€22
Disposal hazardous		€3
Disposal non-hazardous		€15
Treatment		€38
<b>Total €/MT</b>		<b>€120</b>



### SMALL HOUSEHOLD

€ / Metric tonne (MT)

Compliance		€37
De-pollution		€62
Disposal hazardous		€16
Disposal non-hazardous		€10
Treatment		€141
<b>Total €/MT</b>		<b>€266</b>

When looking at the breakdown of the operational costs related to compliance, the following considerations can be made:

- Average auditing costs to proof legal, quality and services compliance vary between €4 (LHHA) and €8 (C&F) per tonne.
- The costs for reporting to authorities, compliance schemes, etc. range between €37 (SHA) and €42 (LHA) per tonne.
- Labour costs are highly dependent on the location of the plant and can vary greatly depending on labour wage across Europe. These costs are highest for CRT and SHA, because these categories require more manual depollution and dismantling.
- Non-hazardous waste disposal costs are usually less than 10% of the total operational costs except for LHA (12%).

Hazardous waste disposal can be significant (13% for CRT - Pb-glass disposal). The figures provide insight in the potential savings in case of non-compliance with various legal requirements (e.g. not-reporting, improper disposal of waste, no waste characterization, etc..):

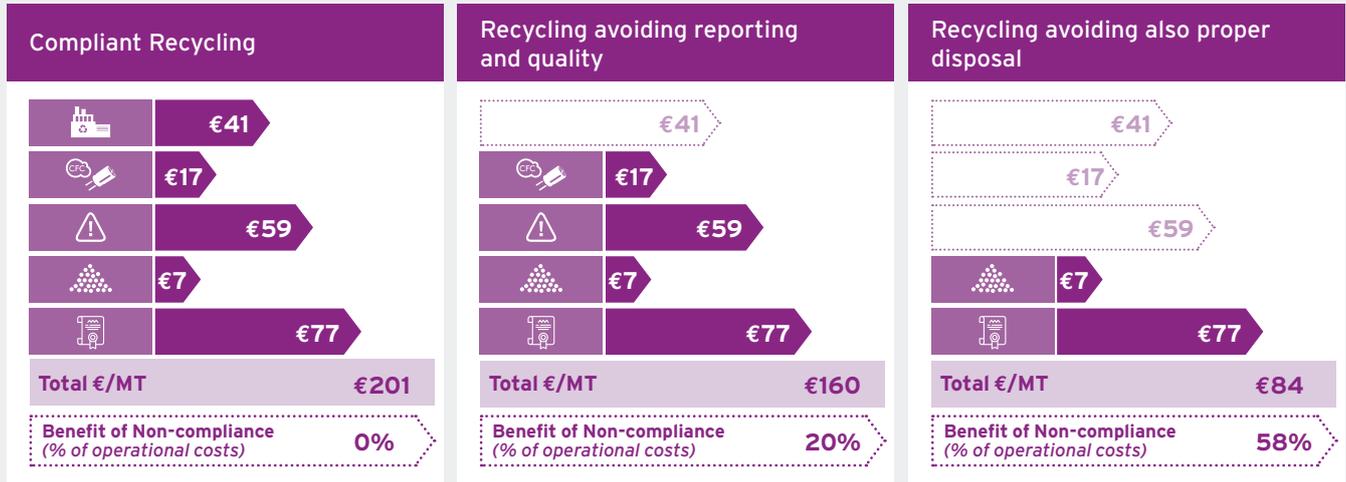
- As a rather black and white scenario, in case no reporting, or fake reporting and no auditing takes place, then a cost reduction of up to 20% of the operational costs can be realised.
- In the case no depollution and proper waste disposal takes place, or fake reporting about this, then a potential 50-60% operational cost reduction can be realised for respectively C&F and CRT treatment.

The potential costs reduction that can be realised by non-compliant treatment exceeds the normal economic margins of legitimate recyclers, applying best available technology - BAT and ensuring full compliance, by far.

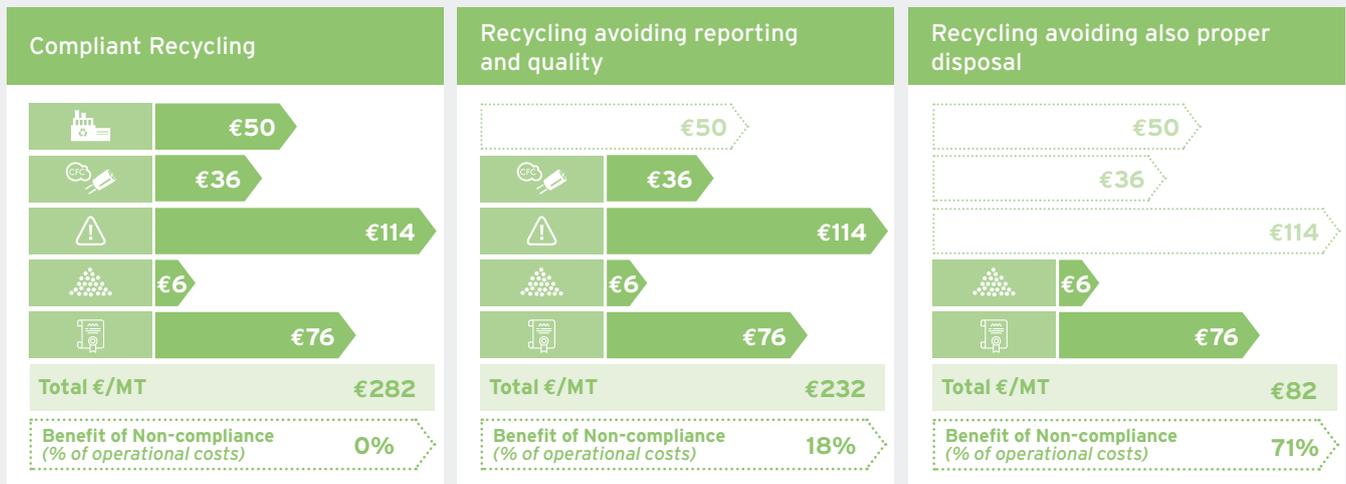
This means that unfair competition by non-compliant recyclers is seriously disrupting the WEEE recycling market and is together with illegal export\* the main reason for an unfair unlevelled playing field in the EU.

\* Countering WEEE Illegal Trade (CWIT) Project - 2015

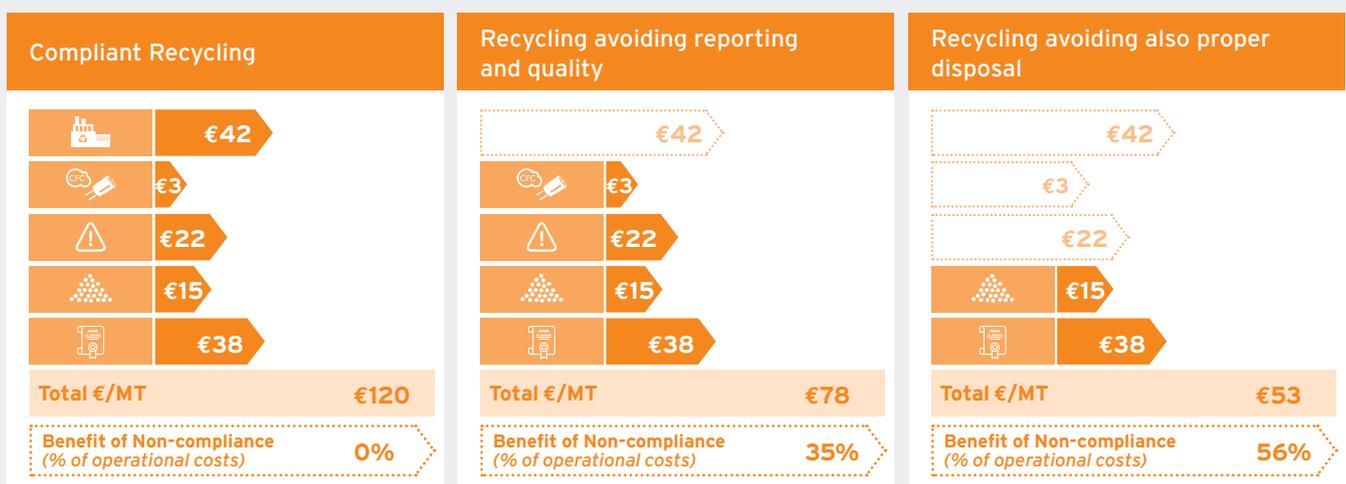
#### POTENTIAL OPERATIONAL COSTS REDUCTION DUE TO NON-COMPLIANT TREATMENT OF C&F (€/MT)



#### POTENTIAL OPERATIONAL COSTS REDUCTION DUE TO NON-COMPLIANT TREATMENT OF CRT'S (€/MT)



#### POTENTIAL OPERATIONAL COSTS REDUCTION DUE TO NON-COMPLIANT TREATMENT OF LHA (€/MT)



## RECOMMENDATIONS

The WEEE Directive legal provisions with regards to financing resulted over the last 10 years in the establishment of compliance schemes by producers in different EU countries. These so-called take back systems are in charge of tenders to purchase logistics and treatment services that are provided by different logistical and recycling companies. In the majority of cases, recyclers bid for these recycling tenders by providing a tariff, usually expressed in €/t. In many countries compliance schemes do index the tariff on the basis of market prices of main commodities (Fe, Al, Cu) and in few cases also on energy price.

But economics or recycling operations depends on two distinct elements:

1. The operational costs of each company, which includes and depends on the level of compliance adopted and services provided, and
2. The material value obtained from the process, which is highly influenced by the quality/scavenging level of incoming material.  
Unfortunately, when there is substantial pressure on the fee provided for the treatment costs, the first cost variable that can be reduced is lowering the quality of treatment and limiting depollution efforts, especially when there is an environment where little to none monitoring and enforcement activities are in place, which is the case in many countries. The second variable 'scavenging' is totally outside the control of the recyclers, but still highly influencing the profitability of the company and the competitiveness when bidding for recycling tenders. While there is general agreement on the need for applying high quality treatment and the creation of a level playing field by means of standards, it is important to understand that:
  - Both adoption and maintaining compliance with technical standards is leading to higher compliance costs,
  - Better tariffs can arise from illegal practices or sub-standard treatment of downstream fractions.
  - Knowledge of the operational costs of compliant recycling is paramount for decisionmakers in order to prevent undesired social, environmental and economic effects.

The pressure from the EEE Industry to reduce or keep costs down easily aid some of the undesired market forces, that are creating economic and social losses.

The scavenging or cherry picking of valuable fractions from E-waste generated is a serious problem which is often beyond the control of compliance schemes and recyclers. Monitoring and reporting on scavenging levels can be a solution between contract partners to create sustainable business practices.

The following recommendations are derived on the basis of the analysis presented above:

1. Establish an "observatory" to monitor the Operational costs among EU recyclers, with tailored cost intervals, on the basis of the first results of this study highlighting typical cost ranges of compliance elements.
2. Consider the definition of minimum Operational costs for auditing and compliance to be excluded from price negotiations with compliance schemes. This should be the common basis, eventually indexed per country, of "non-negotiable costs".
3. Establish an "observatory" to monitor the scavenging level in different countries/markets and define a common basis (indicators based on average market values of fractions) to estimate the economic losses due to scavenging. This might eventually include the assessment of entire products (valuable ones, like mobile phones) in the waste stream, which is further decreasing the intrinsic economic value of the incoming material
4. Consider the inclusion of a "scavenging index" in the negotiation of contracts with compliance scheme as the economic impact of scavenging might be higher than the profit gained on the individual waste stream processing.
5. Improved reporting over collection and treatment should not be seen as a 'luxury item', but as an essential economic requirement to have a level playing field that as a minimum ensures compliant collection and treatment. Specifically, when applying on a Member State level the 'all-actors' model or inclusion of 'substantiated estimates', these should in the long run also be accompanied with making the CENELEC EN 50625 series treatment standards applicable for every operator to ensure proper treatment.

## REFERENCES

### Prosum project:

*Prospecting Secondary raw materials in the Urban mine and Mining wastes*

- [www.prosumproject.eu](http://www.prosumproject.eu)

### CWIT project:

*Countering WEEE Illegal Trade (CWIT)*

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### UNU VIE SCYCLE:

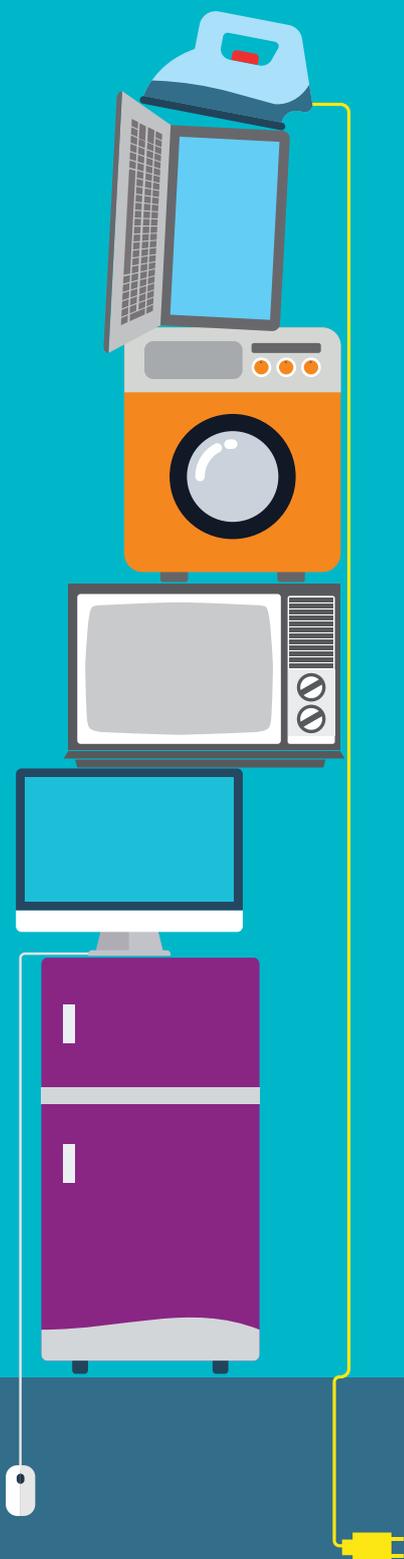
*United Nations University: UNU VIE SCYCLE*

- [ehs.unu.edu/vice-rectorate/sustainable-cycles-scycle#overview](http://ehs.unu.edu/vice-rectorate/sustainable-cycles-scycle#overview)

### EERA:

*European Electronics Recyclers Association*

- [www.eera-recyclers.com](http://www.eera-recyclers.com)



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