



Paper

CRT glass in urban mine forecast

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The following can be used to refer to this report:

Van Straalen V.M. , V. Forti, M. Wagner and C.P. Baldé (2018), CRT glass in urban mine forecast. The Hague, Statistics Netherlands.

1. Introduction

CRT monitors are not in production anymore for many years but they are still present in houses, offices and schools all over the world. These will all become waste at some point in the following years. Good recycling methods are needed to make sure parts can be used to build new products thus lowering the impact on the environment and conserving precious resources.

A big component of the CRT screens is the leaded glass. This report will show the weight of this glass that is predicted to become waste in 2018, 2023 and 2028 and it will show how much of this glass is still left in CRT screens around the world at those times. This data should help in making decisions if investing in innovative recycling procedures is a viable option.

After the presentation of the data there will be a paragraph on the treatment costs of CRT screens.

2. Results

For this report the CRT screens are categorized in computer screens and TV screen. The following section has two tables showing the waste and remaining stock for the computer screens. After that the same tables are shown for the television screens.

2.1 CRT computer screens

Presently in 2018 the total amount of glass in CRT computer monitors is 4,844 kilotonnes (kt). Most of this is found in Northern America (23%), Eastern Asia (19%), Southern Asia and Western Europe (both 10%).

Five years from now in 2023 there will be 2,360 kt left with the most amount found in Northern America (29%), Eastern Asia (24%) and Southern Asia (13%). The stock in Europe will have diminished drastically from 466 kt to 28 kt by then. In 2028 there will be a total of 1,396 kt left in the whole world.

2.1.1 CRT glass from CRT computer screens, WEEE-generated in (metric) tonnes

Region	2018	2023	2028
Australia and New Zealand	7,637	5,218	3,346
Caribbean	964	682	449
Central America	8,739	6,106	3,983
Central Asia	880	620	407
Eastern Africa	2,983	2,163	1,451
Eastern Asia	84,738	58,632	37,969
Eastern Europe	18,793	8,643	5,659
Melanesia	154	109	72
Micronesia	5	4	3
Middle Africa	1,393	998	663
Northern Africa	7,764	5,439	3,555
Northern America	110,087	74,741	47,694
Northern Europe	37,816	1,735	1,117
Polynesia	8	6	4
South America	19,974	14,026	9,186
South-Eastern Asia	21,572	15,127	9,896
Southern Africa	1,834	1,267	820
Southern Asia	42,283	30,451	20,326
Southern Europe	17,254	491	321
Western Africa	7,024	5,080	3,401
Western Asia	18,122	12,467	8,064
Western Europe	42,840	2,868	1,879
Total	452,865	246,872	160,264

2.1.2 CRT glass from CRT computer screens, Urban Mine in tonnes

Region	2018	2023	2028
Australia and New Zealand	79,559	48,819	28,582
Caribbean	10,627	6,666	3,982
Central America	94,458	58,809	34,890
Central Asia	9,647	6,038	3,599
Eastern Africa	34,277	21,834	13,220
Eastern Asia	901,381	557,713	329,004
Eastern Europe	203,328	83,756	49,825
Melanesia	1,711	1,078	646
Micronesia	61	38	23
Middle Africa	15,690	9,921	5,968
Northern Africa	84,284	52,563	31,230
Northern America	1,134,881	693,406	404,348
Northern Europe	404,821	16,337	9,593
Polynesia	92	58	34
South America	217,735	136,010	80,935
South-Eastern Asia	234,577	146,390	87,032
Southern Africa	19,461	12,030	7,091
Southern Asia	480,512	304,868	183,958
Southern Europe	178,237	4,733	2,809
Western Africa	80,364	51,108	30,901
Western Asia	192,328	118,377	69,779
Western Europe	466,391	27,828	16,564
Total	4,844,421	2,358,380	1,394,015

2.2 CRT televisions

2.2.1 CRT glass from CRT televisions, WEEE-generated in tonnes

Region	2018	2023	2028
Australia and New Zealand	11,614	3,149	415
Caribbean	3,440	1,034	149
Central America	54,908	18,101	2,825
Central Asia	3,993	1,156	164
Eastern Africa	7,173	2,393	389
Eastern Asia	314,823	98,083	14,679
Eastern Europe	107,315	15,742	2,001
Melanesia	596	190	30
Micronesia	20	6	1
Middle Africa	3,250	1,331	281
Northern Africa	29,778	8,697	1,214
Northern America	173,098	46,533	6,060
Northern Europe	63,594	1,277	191
Polynesia	45	14	2
South America	61,477	17,269	2,325
South-Eastern Asia	86,296	24,635	3,357
Southern Africa	5,418	1,410	174
Southern Asia	114,117	36,787	5,772
Southern Europe	84,973	1,503	233
Western Africa	13,827	4,266	631
Western Asia	50,208	14,549	2,027
Western Europe	91,031	1,320	196
Total	1,280,995	299,445	43,117

2.2.2 CRT glass from CRT televisions, Urban Mine in tonnes

Region	2018	2023	2028
Australia and New Zealand	36,535	6,390	528
Caribbean	11,618	2,210	202
Central America	197,980	40,500	4,011
Central Asia	13,143	2,446	220
Eastern Africa	26,134	5,478	577
Eastern Asia	1,091,455	214,234	20,656
Eastern Europe	363,102	31,396	2,438
Melanesia	2,103	424	42
Micronesia	71	15	1
Middle Africa	13,911	3,558	489
Northern Africa	98,580	18,261	1,617
Northern America	541,568	93,904	7,711
Northern Europe	197,321	2,789	267
Polynesia	155	30	3
South America	197,967	35,499	2,973
South-Eastern Asia	281,235	51,056	4,416
Southern Africa	16,572	2,763	208
Southern Asia	405,325	82,464	8,322
Southern Europe	280,515	3,345	329
Western Africa	47,599	9,256	880
Western Asia	166,351	30,525	2,697
Western Europe	274,694	2,868	271
Total	4,263,935	639,410	58,861

In 2018 the amount of CRT glass in televisions is 4,264 kt. Eastern Asia has 26% of this, Northern America 13% and Southern Asia 10%. By 2023 the stock will have decreased by almost 85% to only 639 kt worldwide. Most of which is found in Eastern Asia (34%), Northern America (15%) and Southern Asia (13%). By 2028 there is only 59 kt left, again mostly found in the same regions as in the previous years.

3. Treatment costs

Recycling of CRT glass is considered to provide a negative revenue value. This is mainly because the materials contained in these type of products are no longer in high demand or used in many recycled products. Furthermore, it requires manual dismantling and possess risks associated with its recycling. It is estimated that the regaining of lead and glass separation constitute the most cost when recycling this product ('Implementation of the WEEE-directive – economic effects and improvement potentials for reuse and recycling in Germany,' n.d.). However, to avoid environmental and health issue countries and processing centers continue to recycle this type of products.

Treatment costs normally depend on the country and technology applied, on average as stated in the CWIT project and in the EERA study, the treatment cost of CRT ranges between 90–95 euros per tonne ('WEEE recycling economics – EERA,' n.d.), ('CWIT Project – Countering WEEE Illegal Trade,' n.d.). The estimated cost in both cases contemplates Hazardous and Non-Hazardous waste disposal, Line maintenance, Labour processing and depollution, as well as waste characterization.

As seen in the Öko Institute research on 'Recycling options for waste CRT glass, 2014' the treatment costs of the screen and funnel glass oscillate around 50–75 euros per tonne ('Global Circular Economy of Strategic Metals – the Best-of-two-Worlds Approach,' n.d.). When performing estimates on treatment costs both, the CWIT project and the Öko Institute research, take into consideration in their estimates the revenue from the treatment of products (e.g. profit gained from selling processed screen glass).

In the 2014 Öko Institute research, it was estimated that sending alone the funnel glass to a lead smelter facility will have a cost of approximately €50 tonne. Given the aforementioned, it is seen that the profit of reselling processed screen glass from CRTs is not sufficient enough to absorb the treatment costs which would explain why in some countries landfilling of this type of equipment is commonly practiced.

4. Methodology

E-waste calculations for the European union countries has been done based on Prodcum and CN trade data. E-waste calculations for the non-EU countries are coming from the Comtrade International Trade data, based on Harmonized Commodity Description and Coding System (HS).

The calculations are done in a tool developed by Statistics Netherlands (CBS) for Europe and further developed in collaboration with United Nations University (UNU) for the rest of the world. In the case of Europe, it uses European production and trade statistics with the 'apparent consumption method' to estimate sales in weight of products. For the rest of the world, the domestic production is not taken into account because of lack of data. Missing values and unreliable values are corrected based on values of other years or based on values from similar countries. The calculations also use data on life times of electronic and electric equipment, and allows to estimate sales, WEEE and Stock and to forecast the e-waste generated. Other data sources are sometimes used to validate and correct trade data from countries that seem to be incomplete. Available data on possession rates were used to adjust the POM levels. For CRT televisions, data were taken from UNICEF, while for the CRT computer screens the possession rates from ITU data [ITU, 2018] were used to improve the trade data.

The methodology in the tool scripts follow the so-called 'common methodology' to determine Placed on the Market and WEEE Generated as defined in article 7 of the EU-WEEE Directive (Council Directive EC (2012)) and in the world wide guidelines on e-waste statistics developed by the Partnership on Measuring ICT for Development (Baldé, 2015).

This report focuses on the glass in CRT computer and TV screens. Therefore only the glass component of the screens have been taken into account to.

5. References

CWIT Project - Countering WEEE Illegal Trade. (n.d.). Retrieved February 23, 2018, from <http://www.cwitproject.eu>

Dat, L. Q., Truc Linh, D. T., Chou, S.-Y., & Yu, V. F. (2012). Optimizing reverse logistic costs for recycling end-of-life electrical and electronic products. *Expert Systems with Applications*, 39(7), 6380–6387.
<https://doi.org/10.1016/j.eswa.2011.12.031>

Global Circular Economy of Strategic Metals – the Best-of-two-Worlds Approach. (n.d.). Retrieved from <https://www.oeko.de/oekodoc/2061/2014-635-en.pdf>

Implementation of the WEEE-directive– economic effects and improvement potentials for reuse and recycling in Germany. (n.d.). Retrieved from <https://link.springer.com/content/pdf/10.1007%2Fs00170-009-2243-0.pdf>

Queiruga, D., Walther, G., González-Benito, J., & Spengler, T. (2008). Evaluation of sites for the location of WEEE recycling plants in Spain. *Waste Management*, 28(1), 181–190.
<https://doi.org/10.1016/j.wasman.2006.11.001>

WEEE recycling economics - EERA. (n.d.). Retrieved November 13, 2018, from <https://www.eera-recyclers.com/news/weee-recycling-economics>

ITU, 2018. ITU STATISTICS website. Retrieved from <https://www.itu.int/en/ITU-D/Statistics/Pages/default.aspx>

Council Directive EC (2012), Council Directive (EC) 2012/19/EU of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast)

EC, 2018. European Commission, DG Environment website. Retrieved from http://ec.europa.eu/environment/waste/weee/index_en.htm

Baldé, C.P., R. Kuehr, K. Blumenthal, S. F. Gill, J. Huisman, M. Kern, P. Micheli and E. Magpantay (2015), E-waste statistics: Guidelines on classifications, reporting and indicators. Bonn, Germany, United Nations University, UNU IAS – SCYCLE.

Annex 1 Countries per region

The following table shows the countries that are used to calculate the aggregated values of the regions.

Countries per region

ISO	Country	Continent	Region
AFG	Afghanistan	Asia	Southern Asia
AGO	Angola	Africa	Middle Africa
ALB	Albania	Europe	Southern Europe
ARE	United Arab Emirates	Asia	Western Asia
ARG	Argentina	Americas	South America
ARM	Armenia	Asia	Western Asia
ATG	Antigua and Barbuda	Americas	Caribbean
AUS	Australia	Oceania	Australia and New Zealand
AUT	Austria	Europe	Western Europe
AZE	Azerbaijan	Asia	Western Asia
BDI	Burundi	Africa	Eastern Africa
BEL	Belgium	Europe	Western Europe
BEN	Benin	Africa	Western Africa
BFA	Burkina Faso	Africa	Western Africa
BGD	Bangladesh	Asia	Southern Asia
BGR	Bulgaria	Europe	Eastern Europe
BHR	Bahrain	Asia	Western Asia
BHS	Bahamas	Americas	Caribbean
BIH	Bosnia and Herzegovina	Europe	Southern Europe
BLR	Belarus	Europe	Eastern Europe
BLZ	Belize	Americas	Central America
BOL	Bolivia (Plurinational State of)	Americas	South America
BRA	Brazil	Americas	South America
BRB	Barbados	Americas	Caribbean
BRN	Brunei Darussalam	Asia	South-Eastern Asia
BTN	Bhutan	Asia	Southern Asia
BWA	Botswana	Africa	Southern Africa
CAF	Central African Republic	Africa	Middle Africa
CAN	Canada	Americas	Northern America
CHE	Switzerland	Europe	Western Europe
CHL	Chile	Americas	South America
CHN	China	Asia	Eastern Asia
CIV	Côte d'Ivoire	Africa	Western Africa
CMR	Cameroon	Africa	Middle Africa
COG	Congo	Africa	Middle Africa
COL	Colombia	Americas	South America
COM	Comoros	Africa	Eastern Africa
CPV	Cape Verde	Africa	Western Africa
CRI	Costa Rica	Americas	Central America
CYP	Cyprus	Asia	Western Asia
CZE	Czech Republic	Europe	Eastern Europe
DEU	Germany	Europe	Western Europe
DJI	Djibouti	Africa	Eastern Africa
DMA	Dominica	Americas	Caribbean
DNK	Denmark	Europe	Northern Europe

Countries per region (continued)

ISO	Country	Continent	Region
DOM	Dominican Republic	Americas	Caribbean
DZA	Algeria	Africa	Northern Africa
ECU	Ecuador	Americas	South America
EGY	Egypt	Africa	Northern Africa
ERI	Eritrea	Africa	Eastern Africa
ESP	Spain	Europe	Southern Europe
EST	Estonia	Europe	Northern Europe
ETH	Ethiopia	Africa	Eastern Africa
FIN	Finland	Europe	Northern Europe
FJI	Fiji	Oceania	Melanesia
FRA	France	Europe	Western Europe
FSM	Micronesia (Federated States of)	Oceania	Micronesia
GAB	Gabon	Africa	Middle Africa
GBR	United Kingdom of Great Britain and Northern Ireland	Europe	Northern Europe
GEO	Georgia	Asia	Western Asia
GHA	Ghana	Africa	Western Africa
GIN	Guinea	Africa	Western Africa
GMB	Gambia	Africa	Western Africa
GNB	Guinea-Bissau	Africa	Western Africa
GRC	Greece	Europe	Southern Europe
GRD	Grenada	Americas	Caribbean
GTM	Guatemala	Americas	Central America
GUY	Guyana	Americas	South America
HKG	China, Hong Kong Special Administrative Region	Asia	Eastern Asia
HND	Honduras	Americas	Central America
HRV	Croatia	Europe	Southern Europe
HUN	Hungary	Europe	Eastern Europe
IDN	Indonesia	Asia	South-Eastern Asia
IND	India	Asia	Southern Asia
IRL	Ireland	Europe	Northern Europe
IRN	Iran (Islamic Republic of)	Asia	Southern Asia
IRQ	Iraq	Asia	Western Asia
ISL	Iceland	Europe	Northern Europe
ISR	Israel	Asia	Western Asia
ITA	Italy	Europe	Southern Europe
JAM	Jamaica	Americas	Caribbean
JOR	Jordan	Asia	Western Asia
JPN	Japan	Asia	Eastern Asia
KAZ	Kazakhstan	Asia	Central Asia
KEN	Kenya	Africa	Eastern Africa
KGZ	Kyrgyzstan	Asia	Central Asia
KHM	Cambodia	Asia	South-Eastern Asia
KIR	Kiribati	Oceania	Micronesia
KNA	Saint Kitts and Nevis	Americas	Caribbean
KOR	Republic of Korea	Asia	Eastern Asia
KWT	Kuwait	Asia	Western Asia
LAO	Lao People's Democratic Republic	Asia	South-Eastern Asia
LBN	Lebanon	Asia	Western Asia
LBY	Libya	Africa	Northern Africa
LCA	Saint Lucia	Americas	Caribbean
LKA	Sri Lanka	Asia	Southern Asia
LSO	Lesotho	Africa	Southern Africa
LTU	Lithuania	Europe	Northern Europe
LUX	Luxembourg	Europe	Western Europe
LVA	Latvia	Europe	Northern Europe
MAC	China, Macao Special Administrative Region	Asia	Eastern Asia
MAR	Morocco	Africa	Northern Africa
MDA	Republic of Moldova	Europe	Eastern Europe

Countries per region (continued)

ISO	Country	Continent	Region
MDG	Madagascar	Africa	Eastern Africa
MDV	Maldives	Asia	Southern Asia
MEX	Mexico	Americas	Central America
MKD	The former Yugoslav Republic of Macedonia	Europe	Southern Europe
MLI	Mali	Africa	Western Africa
MLT	Malta	Europe	Southern Europe
MMR	Myanmar	Asia	South-Eastern Asia
MNE	Montenegro	Europe	Southern Europe
MNG	Mongolia	Asia	Eastern Asia
MOZ	Mozambique	Africa	Eastern Africa
MRT	Mauritania	Africa	Western Africa
MUS	Mauritius	Africa	Eastern Africa
MWI	Malawi	Africa	Eastern Africa
MYS	Malaysia	Asia	South-Eastern Asia
NAM	Namibia	Africa	Southern Africa
NER	Niger	Africa	Western Africa
NGA	Nigeria	Africa	Western Africa
NIC	Nicaragua	Americas	Central America
NLD	Netherlands	Europe	Western Europe
NOR	Norway	Europe	Northern Europe
NPL	Nepal	Asia	Southern Asia
NZL	New Zealand	Oceania	Australia and New Zealand
OMN	Oman	Asia	Western Asia
PAK	Pakistan	Asia	Southern Asia
PAN	Panama	Americas	Central America
PER	Peru	Americas	South America
PHL	Philippines	Asia	South-Eastern Asia
PLW	Palau	Oceania	Micronesia
PNG	Papua New Guinea	Oceania	Melanesia
POL	Poland	Europe	Eastern Europe
PRT	Portugal	Europe	Southern Europe
PRY	Paraguay	Americas	South America
QAT	Qatar	Asia	Western Asia
ROU	Romania	Europe	Eastern Europe
RUS	Russian Federation	Europe	Eastern Europe
RWA	Rwanda	Africa	Eastern Africa
SAU	Saudi Arabia	Asia	Western Asia
SDN	Sudan	Africa	Northern Africa
SEN	Senegal	Africa	Western Africa
SGP	Singapore	Asia	South-Eastern Asia
SLB	Solomon Islands	Oceania	Melanesia
SLE	Sierra Leone	Africa	Western Africa
SLV	El Salvador	Americas	Central America
SRB	Serbia	Europe	Southern Europe
STP	Sao Tome and Principe	Africa	Middle Africa
SUR	Suriname	Americas	South America
SVK	Slovakia	Europe	Eastern Europe
SVN	Slovenia	Europe	Southern Europe
SWE	Sweden	Europe	Northern Europe
SWZ	Swaziland	Africa	Southern Africa
SYC	Seychelles	Africa	Eastern Africa
TCD	Chad	Africa	Middle Africa
TGO	Togo	Africa	Western Africa
THA	Thailand	Asia	South-Eastern Asia
TKM	Turkmenistan	Asia	Central Asia
TLS	Timor-Leste	Asia	South-Eastern Asia
TON	Tonga	Oceania	Polynesia
TTO	Trinidad and Tobago	Americas	Caribbean

Countries per region (end)

ISO	Country	Continent	Region
TUN	Tunisia	Africa	Northern Africa
TUR	Turkey	Asia	Western Asia
TUV	Tuvalu	Oceania	Polynesia
TZA	United Republic of Tanzania	Africa	Eastern Africa
UGA	Uganda	Africa	Eastern Africa
UKR	Ukraine	Europe	Eastern Europe
URY	Uruguay	Americas	South America
USA	United States of America	Americas	Northern America
VCT	Saint Vincent and the Grenadines	Americas	Caribbean
VEN	Venezuela (Bolivarian Republic of)	Americas	South America
VNM	Viet Nam	Asia	South-Eastern Asia
VUT	Vanuatu	Oceania	Melanesia
WSM	Samoa	Oceania	Polynesia
YEM	Yemen	Asia	Western Asia
ZAF	South Africa	Africa	Southern Africa
ZMB	Zambia	Africa	Eastern Africa
ZWE	Zimbabwe	Africa	Eastern Africa

Explanation of figures

Empty cell	Figure not applicable
.	Figure is unknown, insufficiently reliable or confidential
*	Provisional figure
**	Revised provisional figure
2017–2018	2017 to 2018 inclusive
2017/2018	Average for 2017 to 2018 inclusive
2017/'18	Crop year, financial year, school year, etc., beginning in 2017 and ending in 2018
2015/'16–2017/'18	Crop year, financial year, etc., 2015/'16 to 2017/'18 inclusive

Due to rounding, some totals may not correspond to the sum of the separate figures.

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