Module 12: Challenges and ways forward for policy action – use, reuse and e-waste

Government policies are necessary to ensure that digital devices are used for as long as possible and then properly recycled and also to facilitate these processes. All stakeholders, from governments to manufacturers to users of digital devices, have a responsibility to the environment and to vulnerable people.

Usage and extended life span

As discussed in Module 8, the life span of a digital device can be divided into the first-use and reuse phases.

First-use phase

Goal and targets

The goals in a circular economy are to use a device for as long as is practically possible, to be able to easily repair a device so as to extend its first use, and for the user to be able to dispose of the device in a responsible way at the end of the first-use phase.

Responsibilities

The responsibility for the better and longer use of a device, and its proper disposal, lies with the user of the device. Governments can support better use through regulations and incentives, through tax reform, and by building the capacity of downstream operators in the reuse circuit. Companies can support the better use of a device through transitioning to circular accounting practices, tracking devices in an inventory, and maintaining them properly.

Procedures

There are several considerations in the first-use phase. One is that *single-owner use is socially and environmentally costly.*

Equipment sharing has the potential for higher use rates, as witnessed in Finland.[1] Meanwhile, non-profit *servitisation* computing providers allow environmental responsibility to be shifted from end-users to the service supplier (as owner), while creating a demand for more durable and modular devices to facilitate repairability and upgradeability.[2]

However, the International Financial Reporting Standards (IFRS) 16, which came into effect on 1 January 2019, inhibit leasing. These standards dictate that, in addition to lessors, lessees are now also obliged to report on leased products with a value higher than USD 5,000. This will negatively impact debt, leverage and solvency ratios.[3] IFRS standards are required in more than 140 jurisdictions and used in many parts of the world,[4] which is an obstacle to circularity.

Circular revenue models (CRMs) carry risk from a traditional financial perspective, which needs to be mitigated. According to a study on policy measures needed to promote CRMs:

> The changed financial nature of CRMs makes them more risky from a traditional financial risk assessment point of view. CRMs are characterised by recurring periodic revenue streams and therefore longer payback periods. They also represent a value shift from assets to contracts. […] It is difficult for investors to attribute values to the opportunities regarding circular business models – such as longer product lifetime and higher residual values. Inversely, the risks ascribed to operating with CRMs – such as balance sheet extension, and uncertain income streams in case of B2C [business-to-consumer] models – are dominant.[5]

Government budgeting also makes circular models more difficult to implement. As the same study notes, the structure of governmental budgets sometimes makes it difficult to operate with CRMs (investment vs. operational budgets). This results in governments choosing purchase instead of engaging in more CRMs, when they could be setting an example and playing a major role in the transition towards a circular economy.[6]

Depreciation of digital devices in accounting limits the circular economy. To correct this, this tax revisions might be necessary:

> Businesses are stimulated to depreciate products quickly and down to €0, as this increases the tax benefits that they can obtain. This rapid depreciation lowers the perceived market value of used products, which is a barrier to the development of a circular economy for which used product value is a necessary precondition. Furthermore, depreciation standards also limit the maximum length of rental, lease or pay-per-use periods.[7]

With respect to proper disposal, public and private organisations should publish *audited environmental impact reports.* Without audits, all claims are just marketing. In Europe, the European Commission non-financial reporting directive[8] requires large public interest entities

with over 500 employees (listed companies, banks and insurance companies) to disclose certain non-financial information. There are guidelines on reporting climate-related information to promote more sustainable activities. These reports should translate into tax penalties or benefits.

Reuse

Goal and targets

The reuse sector is key for extending the life span of digital devices, working towards social inclusion, and expanding access to devices for a wider range of the population. As discussed in Module 8, once a device has reached the end of the first-use phase, it can be refurbished to extend its usefulness for different purposes. Working parts can also be scavenged from no longer usable devices for reuse in other devices, and parts can be recycled to recover secondary materials.

Responsibilities

Social enterprises can develop sustainable operations to implement circular consumption models that generate good quality jobs for social inclusion. Governments can create incentives for the reuse sector. Businesses can support reuse initiatives through corporate social responsibility and other programmes.

Procedures

There are several policy considerations in relation to reuse. For example, current tax structures impact on repair and resale and may be inherited procedures and policies from linear models. In particular, there is a need to reconsider the *tax structures impacting on labour and resources*. In the EU, 51% of tax revenues come from labour taxes, while only 6% come from resource taxes. As the abovementioned study on policy measures to promote CRMs explains:

> A shift of taxes from labour to resources will stimulate the adoption of circular business models as maintenance, repair and refurbishing activities are labour-intensive and resource-extensive. […] Rather than taxing labour, a carbon tax can be initiated which will tax the use of natural resources and pollution.[9]

In addition, *fiscal or tax incentives* should be considered for activities with a reported impact for the common good (socio-environmental), such as the donation of devices (similar to tax deductions for charitable organisations) and for activities that help to extend device life spans (such as incentives for repair and reuse by individuals and organisations). These incentives should reward adding value instead of throwing devices away, or device use-and-share models that benefit society and the environment, instead of ownership.[10]

The European Right to Repair campaign, repair.eu, advocates for *zero tax* – including value-added tax (VAT) – for repair and refurbishment, as the social and environmental benefits exceed the amount of tax paid.

Another point to consider is that *several social enterprises working on the collection, refurbishment, maintenance and recycling of devices are necessary.* One single person (especially a volunteer) or a single organisation (such as a social enterprise) cannot serve all the needs for refurbished devices. We need several diverse organisations to attend to supply, especially for the industrial-volume management of devices from organisational donors that act as umbrella organisations for a group of social enterprises. The Flanders region in Belgium, which already had circular economy activities in 1993, has more than 120 reuse centres managed by 31 social enterprises. These have the strong support of the regional government and local authorities.[11]

In addition, long-term agreements for the *guaranteed supply of devices* for reuse are essential for the sustainability of the activity, and this requires hard work on institutional relations with governmental activities and programmes and companies to collect devices.[12]

In Spain, the eReuse community has developed *public agreements* for donation, wherein the City of Barcelona agrees to donate all their unused (end-of-use, inactive) devices to a federation of social refurbishment organisations (referred to as the Pangea circuit). The devices offered by the city council are distributed across the participant organisations according to capacity and demand, after triage for reuse or recycling. The devices refurbished for reuse must go to vulnerable users, usually supported by a social organisation.[13] All devices should be recycled at the end of their life span.

Data is critical in the reuse value chain. Reuse without traceability for accountability that promotes final recycling becomes an environmental problem, as recycling cannot be enforced. This requires policies to avoid “environmental impact laundering” or “CO2 laundering”. There are software tools to collect data and identifiers of devices; to keep a device inventory across different users, such as records of usage and key milestones during the life span of a device (registration, repair, data wipe, transfer to a new user, upgrade, final recycling);[14] and to generate overall impact reports. The Pangea eReuse circuit commits to reporting traceability information back to the City of Barcelona, which records information such as extended usage hours and final recycling. This allows for the resulting social and environmental impact from a donation to be estimated.

Data also helps us to measure the social benefit of a reuse centre as an activity. According to a 2018 study by Samenwerkingsverband Sociale Tewerkstelling,[15] the *reintegration* of one unemployed person through a reuse centre or a social enterprise generated EUR 12,000 in net return to the government and society.

Funding *research and experimentation* to prolong the life span of digital devices and enable their reuse, as is the case in Finland,[16] is another recommended procedure.

As a measure to help economic sustainability, social enterprises that achieve certified social and environmental benefits should be able to benefit from *environmental impact bonds*[17] and *social impact bonds* set up for *public investment.*

E-waste

Goal and targets

The ultimate goal should be that a device that is no longer useful to anyone can be dismantled and recycled with minimal negative impact on the environment. Extracting useful parts and the maximum amount of useful secondary raw materials, as circular resources for the repair or manufacture of other devices, is the aim of the circular economy.

Responsibilities

Governments are responsible for regulating the recycling of e-waste, including the recovery of parts and materials and restricting e-waste dumping.

Manufacturers have a producer's responsibility for the proper recycling of their devices that are sold, used and disposed of in markets.

Users who own their devices, including organisations, companies and institutions, have the responsibility to deliver these devices to recycling centres or initiatives that can recycle them in the proper way.

Procedures

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal provides a global *regulation of hazardous waste shipments* to countries, which also applies to e-waste. However, the definition of waste is not always clear. As a result of different socioeconomic needs, e-waste in one country can be an e-resource in another, with the possibility of discarded digital devices being repaired or reused. The negative side of this ambiguity in definition results in e-waste being exported to countries that cannot handle it, with devastating social and environmental consequences. The Global E-waste Monitor 2020 states:

The distinction of whether something is waste or not, and therefore intended for reuse, is a longstanding discussion under the Basel Convention. […] A final consensus has still not been reached concerning the definition of waste.[18]

“Bilokos”

In the Democratic Republic of Congo, there is no policy for the recycling of computer or telephone equipment, which is done informally. For many years, informal traders have imported second-hand goods from Europe for resale in Africa. Commonly called “bilokos” (or “below cost”), imported second-hand computers typically have manufacturing defect,s but after some repair they are sold at low prices to allow those have limited budgets to purchase a device. Even large stores selling new electronic products have maintenance departments that repair defective computers that are then sold.

E-waste policies, legislation and regulations protect formal and informal workers, the public and the environment. However, not every region and country has policies for recycling digital devices in place. According to the Global E-waste Monitor 2020, as of October 2019, 71% of the world’s population was covered by a national e-waste policy, legislation or regulation. Less than half of all countries in the world were covered by a policy, legislation or regulation at that time.[19]

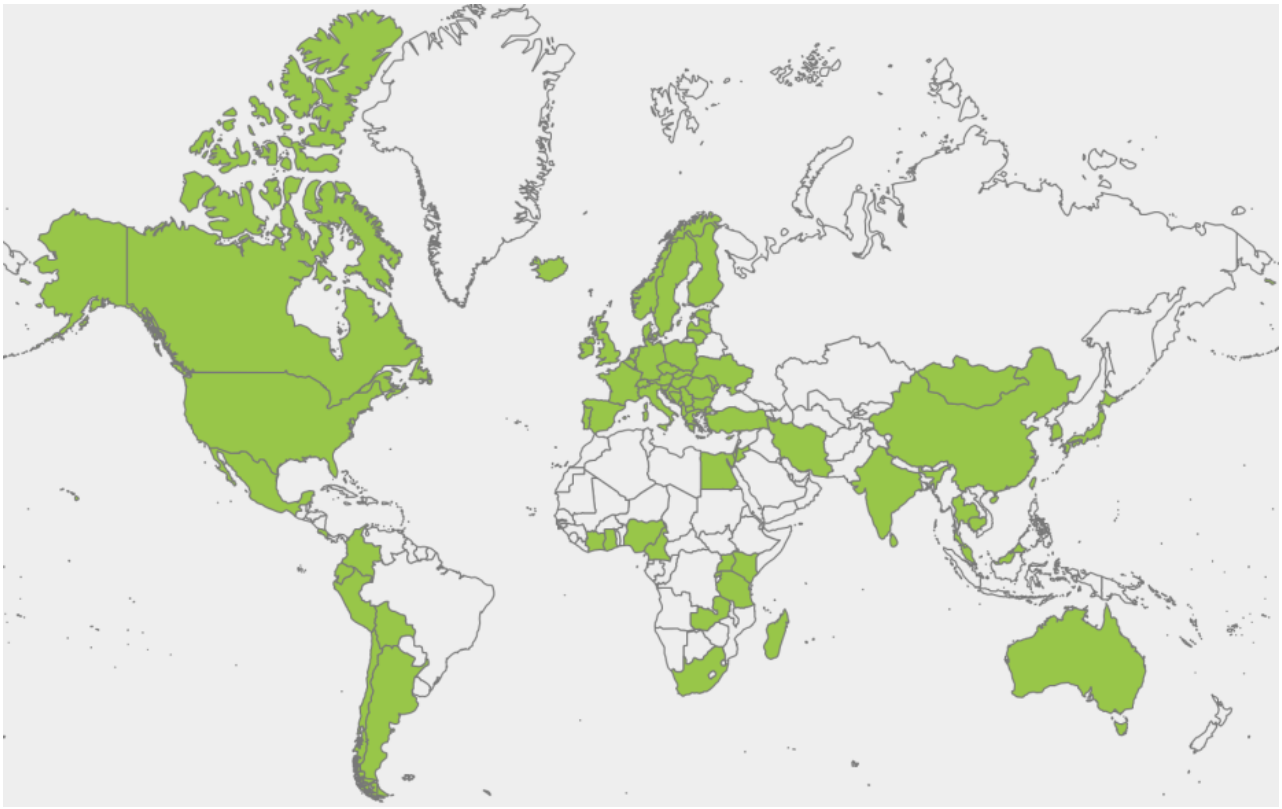

Figure 12: Countries coloured green had national environmental protection laws specifically designed for e-waste in 2019. (Source https://globalewaste.org/map)

Moreover, waste legislation often inhibits the reuse of e-waste because, formally, only certain authorised actors can return something that was declared e-waste as a useful e-resource. In the European Union, for example:

> The current Waste Framework Directive (WFD) definition of waste dictates that a substance owner’s behaviour determines whether a resource is seen as waste instead of the

substance's properties. Under this legislation too many substances are classified as waste, and innovative repurposing is not taken into account. When a substance has been classified as waste, one is prohibited to trade, mediate, transfer or receive it without registration or permit.[20]

Recommendations are therefore necessary to strengthen policies on e-waste management.

All this points to the need to *advocate with the government to set up an e-waste management system* (legislation, regulation, monitoring) to regulate the recycling of digital devices and the handling of those that cannot be recycled according to established standards. If devices are recycled prematurely, manufacturers and recyclers should pay the social, environmental and economic costs (future opportunity cost) of having to manufacture new devices. If devices are recycled badly (for example, due to insufficient investment), this results in the non-recovery of many materials that cost more to extract through mining than the value of the raw materials obtained.

According to the Global E-waste Monitor 2020,[21] e-waste legislation or regulation must include:

- Definitions for the role of municipalities and the government.
- A clear definition of who is responsible for organising the collection and recycling of the e-waste.
- A clear definition of who is responsible for financing the e-waste collection and recycling.
- National alignment on definitions of e-waste.
- A permitting and licensing structure for e-waste collectors and recyclers.
- A clear definition of "producer", if the system is based on the extended producer responsibility (EPR) principle. Without this, no producer will feel obliged to comply, and the fair enforcement of legal provisions across industry will be more difficult.
- The allocation of collection and recycling obligations among producers.
- A description of how companies will register as "producers".
- Documentation of their compliance status and a clear description of the goals and targets of the legislation.

Some other mechanisms and issues to consider are:

- *Landfill taxation* of industrial waste, a per-unit waste disposal tariff.
- *Required ratios and quotas for recycling and preparation for reuse.* In other words, recycling everything is not allowed – there must be a minimum quota for preparation for reuse. For instance, Spain set a preparation for reuse target in its national waste plan (for 2016 to 2022), of 50% by 2020, of which 2% will be preparation for reuse from waste electrical and electronic equipment (WEEE).[22]
- The *separate collection of e-waste,* which allows for its specific treatment and recycling.
- The role of *informal waste recyclers* in the e-waste management system. How does formalising the system (such as creating formal jobs and businesses) impact on their livelihoods? What can be done to properly include them in the recycling value chain?
- *E-waste management as a public service*. Some specialists see e-waste management as *not profitable,* because it involves tasks that no one wants to pay for. The activity should be considered a public service

, as with the treatment of other types of waste, and not only as an economic activity.[23]

- The government should reserve certain *public bids for activities related to recycling* for *social inclusion organisations* only (not for commercial entities). This will allow these bids to have not only environmental benefits, but also a social impact by means of stimulating social inclusion.[24]

In addition to advocating for an effective e-waste management plan, civil society has a specific role to play in:

- *Educating the community* in the good management of e-waste.
- *Mapping the potential for reuse and repair of e-waste* deposited at recycling facilities through comprehensive research. For example, this could include the analysis of potential for and barriers to proper e-waste management in collaboration with relevant stakeholders, a survey of the potential of the equipment delivered to recycling centres, and quantification of the environmental benefit.[25]
- Supporting the development of *national e-waste statistics.* Since 2017, the Global E-waste Statistics Partnership has made substantial national and regional progress by organising workshops on e-waste statistics in various countries. So far, regional capacity-building workshops have been conducted in East Africa, Latin America, Eastern Europe and the Arab states.[26]

Policy action template checklists

	Mining and extraction	**Design and manufacturing**	**Procurement**	**Use, repair, reuse**	**Recycling and management of e-waste**	**Import/export, taxation**
Local community	Converting informal workers to formal workers through cooperatives or social enterprises	Local labour unions in manufacturing factories	Local buying clubs, procurement consortia	Diverse communities, repair networks	Cooperatives or social enterprises	Not applicable

Environmental activists and NGOs	Independent monitoring of mines, public campaigns	Public campaignsfor ecodesignand circulardesign, independent monitoring of repairability and durability	Promote socially and environmentally responsible practices and accountability	Promote socially and environmentally responsible practices and accountability	Promote socially and environmentally responsible practices and accountability	Promote socially and environmentally responsible practices and accountability
Regulators	Auditability, certification	Auditability	Auditability	Auditability	Extended producer responsibility	Auditability
Policy makers	Regulation, monitoring, incentives, penalties	Type approval	Promotion of responsible public procurement and procurement consortia	No taxes on repaired devices	National e-waste policies	Circular economy policies that incorporate taxation
Public institutions	Awareness of and sensitivity to risks, responsibilities	Awareness of and sensitivity to risks, responsibilities	Responsible public procurement	Incorporated into public procurement, responsible maintenance, responsible disposal (maximise reuse over recycling)	Responsibility for environmental and social impacts, accountability	Preference for local suppliers
Brands and manufacturers	Corporate responsibility for supply chain	Design for repairability, interoperability	Transparency for individual and volume buyers	Documentation, accountability, spare parts	Documentation, extended producer responsibility	Compliance with national and international standards, transparency

	Mining and extraction	Design	Manufacture	Procurement	Use, repair, reuse	Recycling and management of electronic waste
Education and awareness			Manuals		Public education	
Economic instruments	Carbon tax		Material consumption tax, carbon tax	Carbon tax	Carbon tax, differentiated VAT rate for reuse and repair	Waste disposal tariff, landfill tax
Information-based	Open data reporting	Certification of secondary (recycled) materials input	Labelling on % raw materials input, recyclability, repairability, durability, chemical and material composition			
Requirements and regulation	Transparency around sources, labour and environmental conditions	Durability, repairability, recyclability (ecodesign)	Extended producer responsibility, transparency around sources, labour and environmental conditions	Sharing economy		EOL-RR[27] final disposal quota, waste shipments
Public provision	Public research and development	Public research and development	Public research and development	Green public procurement, public research and development	Public research and development, depreciation rules, public education	Public research and development, separated collection
Private provision	Open data, auditing	Open-data, auditing	Open-data, auditing, service manuals	Circular leasing	Open data, auditing	Open data, auditing
Citizens/CSOs	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring

Appendix 3. Related existing policy recommendations

There are several global frameworks for policy on digital devices worth mentioning, which include the following examples.

In response to the e-waste challenge, ITU-T Resolution 200 was revised at the International Telecommunication Union (ITU) Plenipotentiary Conference in Dubai, 2018, which established the Connect 2030 Agenda. This agenda is a global initiative headed by the ITU. It sets out the shared vision, goals and targets for global telecommunication and information and communication technology (ICT) development that member states have committed to achieve by 2030.

Among other targets, the Connect 2030 Agenda has called for such goals as “By 2023, increase the global e-waste recycling rate to 30%” (Target 3.2) and “By 2023, raise the percentage of countries with an e-waste legislation to 50%” (Target 3.3).

The Connect 2030 Agenda is linked to the ITU Strategic Plan for 2020 to 2023, ensuring that technology serves humanity and the planet by means of bold goals: growth, inclusiveness, sustainability, innovation and partnerships.

In January 2020, the ITU also issued ITU-T Recommendation L.1470: GHG emissions trajectories for the ICT sector compatible with the UNFCCC Paris Agreement. This recommendation, developed in collaboration with GeSI, GSMA and the Science-Based Targets initiative (SBTi), provides ICT companies with trajectories relating to reduction of greenhouse gas emissions in order to meet the targets outlined in the Paris Agreement. Additional specificities on the trajectories are set out in a document that accompanies the recommendation, Guidance for ICT companies setting science-based targets.

The term "net zero" is increasingly used to describe a more comprehensive commitment to decarbonisation and climate action, moving beyond carbon neutrality and often including a science-based target on emissions reduction, as opposed to relying solely on offsetting.

As discussed in this module, the UN’s Basel Convention aims at suppressing the trade in hazardous waste, including e-waste. In terms of waste, the Convention is useful to develop national policies. Its objectives on e-waste are to:

- Contribute towards developing national e-waste inventories and policies for the implementation of the Basel Convention.
- Test and disseminate the e-waste technical guidelines.
- Facilitate collection and exchange of best practices with regard to environmentally sound management of e-waste among parties, including information on new technologies and cleaner production methods to prevent and minimise the production of hazardous e-

waste.

- Disseminate information on policy tools, certification schemes and regional initiatives to manage e-waste in an environmentally sound manner, with the inclusion of success stories on turning waste into resources, material recovery and recycling.
- Organise training activities on enforcement to enhance parties' capacities to monitor and control e-waste transboundary shipments and enforce the Basel Convention.

Finally, a report published by the Organisation for Economic Co-operation and Development (OECD), *The Macroeconomics of the Circular Economy Transition*,[28] provides domestic policy recommendations for countries seeking to make this transition, including:

- Extended producer responsibility (EPR) schemes.
- Standards for recycled materials.
- Requirements to secure information on the chemical and material composition of products.
- Phasing out hazardous substances from products by:
  - Revisiting trade disciplines
  - Considering global or regional recyclability and reparability standards
  - Requirements regarding ecodesign
  - Requirements to provide information on chemical and material composition of products.
  - Mutual recognition of schemes.

		Masui (2005)	Distelkamp et al. (2010)	Ekins et al. (2012)	Cambridge Economics (2014)	Godzinski (2015)	Schandl et al. (2016)	Soderman et al. (2016)	UNEP (2017)	Bosello et al. (2016)	Hu et al. (2016)	Meyer et al. (2016)
Economic Instruments	Landfill taxation					■		■				
	Carbon tax			■			■					
	Per-unit waste disposal tariff							■				
	Material consumption tax		■	■	■	■		■	■	■	■	■
	Differentiated VAT rate		■					■				
	Targeted subsidies					■						■
Information Based	Labelling: % raw material inputs	■							■			
	Labelling: recyclability/repairability	■							■			
	Public education programs	■							■	■	■	■
	Collaborative platforms											
	Certification scheme: secondary inputs											
Eco Design	EPR											
	Ecodesign requirement: durability										■	
	Ecodesign requirement: repairability										■	
	Ecodesign requirement: recyclability		■								■	
Other Regulation	Recycling rate standard (on EOL-RR)		■			■					■	■
	Final disposal quota	■				■					■	■
	Reform of end of waste rules											
	Waste shipments: proper enforcement											
	Sharing Economy regulatory framework											
Public Provision	Green public procurement											
	Targeted public R&D	■	■		■		■	■	■	■	■	■
	Services e.g., separated collection											

Summary of policy coverage in selected studies. Source: OECD (https://doi.org/10.1787/af983f9a-en)

Footnotes

[1] Wilts, C. H., Bahn-Walkowiak, B., & Hoogeveen, Y. (2018). *Waste prevention in Europe: Policies, status and trends in reuse in 2017*. European Environment Agency. https://doi.org/10.2800/15583

[2] ITU-T. (2021). *Recommendation L. 1024: The potential impact of selling services instead of equipment on waste creation and the environment – Effects on global information and communication technology*. ITU. https://www.itu.int/rec/T-REC-L.1024-202101-I/en; for an example of a servitisation model, see the eReuse case study in this guide.

[3] Copper8, Kennedy van der Laan, & KPMG. (2019). *Circular Revenue Models: Required Policy Changes for the Transition to a Circular Economy*. https://www.copper8.com/en/circulaire-verdienmodellen-barrieres

[4] Including South Korea, Brazil, the European Union, India, Hong Kong, Australia, Malaysia, Pakistan, Gulf Cooperation Council (GCC) countries, Russia, Chile, Philippines, Kenya, South Africa, Singapore and Turkey.

[5] Copper8, Kennedy van der Laan, & KPMG. (2019). Op. cit.

[6] Ibid.

[7] Ibid.

[8] European Commission. (2017). *Commission guidelines on non-financial reporting*. https://ec.europa.eu/info/publications/non-financial-reporting-guidelines_en

[9] Copper8, Kennedy van der Laan, & KPMG. (2019). Op. cit.

[10] Roura Salietti, M., Flores Morcillo , J., Franquesa, D., & Navarro, L. (2020). Reusing computer devices: The social impact and reduced environmental impact of a circular approach. In A. Finlay (Ed.), *Global Information Society Watch 2020: Technology, the environment and a sustainable world: Responses from the global South*. APC & Sida. https://www.giswatch.org/node/6270

[11] European Commission. (2019, 18 November). Leading the way in closing the loop: Circular Flanders. https://ec.europa.eu/environment/ecoap/about-eco-innovation/policies-matters/leading-way-closing-loop-circular-flanders_en

[12] For a more in-depth exploration of this issue, see the Nodo TAU case study in this guide.

[13] Roura, M., Franquesa, D., Navarro, L., & Meseguer, R. (2021). Circular digital devices: lessons about the social and planetary boundaries. In *LIMITS '21: Workshop on Computing within Limits*. https://computingwithinlimits.org/2021/papers/limits21-roura.pdf

[14] Franquesa, D., Navarro, L., López, D., Bustamante, X., & Lamora, S. (2015). Breaking barriers on reuse of digital devices ensuring final recycling. In *Proceedings of EnviroInfo and ICT for Sustainability 2015*. Atlantis Press. https://dx.doi.org/10.2991/ict4s-env-15.2015.32

[15] Samenwerkingsverband Sociale Tewerkstelling. (2018). *Sociale tewerkstelling met de reguliere economie.*. https://docplayer.nl/19740199-Sociale-tewerkstelling-in-synergie-met-de-reguliere-economie.html

[16] Wilts, C. H., Bahn-Walkowiak, B., & Hoogeveen, Y. (2018). Op. cit.

[17] Thompson, A. (2020, 2 July). Environmental Impact Bonds: Where are they now? *UNC Environmental Finance Center*. https://efc.web.unc.edu/2020/07/02/environmental-impact-bonds-where-are-they-now

[18] Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2020). *The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential*. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR) – co-hosted SCYCLE Programme, International Telecommunication Union (ITU) & International Solid Waste Association (ISWA). http://ewastemonitor.info/wp-content/uploads/2020/07/GEM_2020_def_july1_low.pdf

[19] Ibid.

[20] Copper8, Kennedy van der Laan, & KPMG. (2019). Op. cit.

[21] Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2020). Op. cit.

[22] RREUSE. (2016, 28 April). Spain first country to set target to stop reusable goods ending up in landfill. https://www.rreuse.org/spain-first-country-to-set-target-to-stop-reusable-goods-ending-up-in-landfill

[23] Fernández Protomastro, G. (2013). *Minería Urbana y la Gestión de los RAEE*. Ediciones Isalud. https://sigraee.files.wordpress.com/2013/10/libro-raee-completo.pdf

[24] RREUSE. (2016, 28 April). Op. cit.

[25] Wilts, C. H., Bahn-Walkowiak, B., & Hoogeveen, Y. (2018). Op. cit.

[26] Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2020). Op. cit.

[27] EOL-RR is the end-of-life recycling rate, or the share of a material in waste flows that is actually recycled (from an output perspective).

[28] McCarthy, A., Dellink, R., & Bibas, R. (2018). *The Macroeconomics of the Circular Economy Transition: A Critical Review of Modelling Approaches*. OECD. http://dx.doi.org/10.1787/af983f9a-en

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