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Encouraging the transition to a Circular ICT sector in Malaysia

Approaches, challenges and recommendations for the Malaysian Government

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List of Abbreviations

CM	Contract Manufacturer
EEE	Electric and Electronic Equipment
EPR	Extended Producer Responsibility
EU	European Union
GGP	Government Green Procurement
GHG	Greenhouse Gas
GPP	Green Public Procurement
IC	Integrated Circuit
ICT	Information and Communication Technology
OEM	Original Equipment Manufacturer
PC	Personal Computer
PCB	Printed Circuit Board
PCR	Post-Consumer Recycled
SME	Small or Medium-sized Enterprise
WEEE	Waste from Electrical and Electronic Equipment

Summary

According to the 2023 Circularity Gap Report, over 90% of all materials extracted from the planet by humans end up as waste. This waste of resources has serious implications for climate change, with as much as 70% of all global greenhouse gas emissions being linked to the handling and use of materials (Circle Economy 2022; 2023). Without tackling resource consumption and resource waste, it will be impossible to achieve the emission reduction targets of the Paris Agreement as well as the Sustainable Development Goals (particularly Goal 12 – Sustainable Consumption and Production) (IPR 2018).

A transition in how we consume resources is therefore required, and the circular economy offers a new model for maintaining materials in the economy while designing out materials and waste. To achieve a circular economy a new mode of collaboration along the whole supply chain of products is needed. This will require intervention from governments, who have the power to align regulations, enablers and incentives in support of the circular transition.

This study, funded by the GIZ in cooperation with the Global Solutions Initiative, therefore aims to develop recommendations for improving the circularity of the Information Communication Technology (ICT) value chain in Malaysia, as an example of how an emerging economy with a significant manufacturing base can react to global trends and future-proof its industry.

The recommendations have been developed on the basis of an analysis of global trends in circular economy policy and practice combined with research into the current awareness and practice of the ICT sector in Malaysia. They include creating demand for circular products (through minimum standards as well as incentives to improve performance); improving waste management (by enhancing the capture of valuable resources from both national and global waste streams); and, increasing capacities within the Malaysian ICT manufacturing sector (through awareness raising, capacity building, as well as financial incentives).

1 Introduction

Information and Communication Technology (ICT) has become a fundamental part of our world, but its use also comes with major environmental impacts. Studies have estimated the overall contribution of ICT devices to global greenhouse gas emissions as being anywhere within the range of 1.8% to 3.9% of total emissions (Freitag et al. 2021). In addition, the manufacturing and disposal of ICT devices has localised environmental and social impacts, including air and water pollution and impacts on natural ecosystems and biodiversity.

For this reason, a growing number of governmental, environmental and economic actors alike have seized upon the circular economy as a means for meeting society's material needs while respecting environmental boundaries. Unlike the 'take-make-dispose' model of the traditional linear economy, a circular economy can be understood as a "regenerative system" which maintains materials in the economy while designing out waste and negative impacts (Prakash et al. 2022). In the ICT sector, the transition to a circular economy must therefore include design based strategies which extend the lifetime of devices and components (thus slowing resource flows), and which improve the recyclability of devices and the use of recycled materials (thus closing resource flows).

Major global actors such as the European Union (EU) and China have already launched several policies which seek to promote a transition to a circular economy, such as initiatives to promote circular industrial development as well as regulate out non-circular products. In addition, a number of global ICT brands and Original Equipment Manufacturers (OEMs) are also increasing their focus on circular economy, at the same time as new market entrants are seeking to carve out circular business opportunities.

Although yet to be seen at scale, it can be expected that the new priorities of internationally influential governmental and private sector actors will lead to shifts in the structure of ICT supply chain. This will present new challenges for emerging economies with industrial bases shaped over decades to fit into global linear ICT supply chains, such as Malaysia, which relies on its electric and electronic equipment (EEE) sector for around 38% of its total exports (Department of Statistics Malaysia).

In order to prepare for and support the needed transition to a circular economy, it is necessary that emerging economies take steps to seize new circular economy opportunities and facilitate the transition of existing industry. This study therefore seeks to further our understanding of how the ICT supply chain reacts to the policies and initiatives of influential global actors, and to devise recommendations for policymakers in emerging economies seeking to capture circular opportunities. As an example, Malaysia has been selected as the focus of this study, given the relative importance of the ICT supply chain to its economy, as well as its commitment to advancing circular economy as expressed in the Twelfth Five-Year Malaysia Plan (2021-2025).

This study was carried out by Oeko-Institut and Uniutama Education and Consultancy. The study included interviews with:

- two major OEMs,
- one innovative market entrant specialised in repairable devices,
- one ICT certification body, and
- 14 supply-chain companies located in Malaysia.

This was supplemented with desk research, including

- a review of the sustainability reports of the 15 largest ICT brands/ OEMs[1] and Contract Manufacturers (CMs) with known operations in Malaysia for references to explicit processes, standards or methods for improving circular design practices along the ICT value chain, and
- a survey on circular economy awareness and practice (circulated in December 2022) that was answered by an additional 25 Malaysian supply chain actors.

1.1 Lifecycle environmental impacts of ICT products

According to the 2023 Circularity Gap Report, over 90% of all materials extracted from the planet by humans end up as waste. This waste of resources has serious implications for climate change, with as much as 70% of all global greenhouse gas emissions being linked to the handling and use of materials (Circle Economy 2022; 2023). The United Nations Resources Council estimates that just the extraction and further processing of raw materials (biomass, metals, non-metallic minerals and fossil fuels) contributes to around 50% of global GHG emissions, as well as over 90% of biodiversity loss and water stress (International Resource Panel 2019).

The impacts of the electronics sector marks it out as a priority for action. Globally, demand for electronic products is increasing by 2.5 million metric tonnes per year. A large portion of this can be classed as ICT, including computers, laptops, tablets and smartphones. Smartphones are estimated to have already reached a penetration rate of 78% of the global population (Statistica 2022a), while it is estimated that over 47% of households worldwide now have a personal computer (PC) (Statistica 2022b). This rate will grow as living standards in developing countries rise.

Studies have estimated the overall contribution of ICT devices to global greenhouse gas emissions between 1.8%-2.8% to as high as 2.1%-3.9% (Freitag et al. 2021). ICT devices also have localised environmental and social impacts along their full life cycle, including air and water pollution and impacts on natural ecosystems. The main environmental impacts at each stage are described below.

Raw material extraction: ICT devices are intensive users of rare metals, including indium in touch screens and displays, cobalt and lithium in batteries, and gold, silver, platinum, tantalum, tungsten and copper in electronic boards (Alfieri et al. 2021). The majority of raw materials used in ICT manufacture are still sourced from primary extraction which leads to pollution and overuse of water (EEA 2020b), as well as the destruction of habitats and ecosystems.

1 as identified in Alfieri et al. (2021).

Another issue is the geographical concentration of rare metals in countries with weak regulatory frameworks, as this can exacerbate the environmental and social problems associated with material extraction. For example, in 2014 around 9.4% of cobalt mined globally was used in smartphones and tablets. Of this, more than 50% was mined in the Democratic Republic of the Congo, where the mining sector is largely unregulated, leading to land degradation, loss of agricultural opportunities, and emission of heavy metals to water, soil and air. Mining is commonly done by artisanal methods, meaning often fatally dangerous conditions for workers, including children (Mannhart et al. 2016). Palladium is another issue mineral. 8.9% of global extraction is used in smartphones and tablets, 43% coming from mines in Russia, specifically Norilsk, which is considered within the top ten most polluted places on earth due to its smelting industry (Mannhart et al. 2016).

Manufacturing: In terms of global warming potential, manufacturing is the life cycle stage of ICT with the highest environmental impact, contributing 64% of a desktop PCs total greenhouse gas potential (THG100), 83% of a notebooks THG100 (Prakash et al. 2016), or 75% of a smartphone (Alfieri et al. 2021).

The components with the highest global warming potential are printed circuit boards (PCBs) and ICs. This is largely due to the high amount of energy needed in the semiconductor manufacturing process, but also because the impacts of mining and processing minerals such as gold are included (Alfieri et al. 2021). PC and laptop monitors also have a high manufacturing impact, as do tablet and smartphone displays (Alfieri et al. 2021).

Reasons for high energy demands in the manufacturing stage include clean-room requirements (clean-rooms control the levels of pollutants in the manufacturing areas through the use of heating, ventilation and air conditioning (HVAC) systems, which are major consumers of energy); use of compressed air (compressed air is used to clean components and to power manufacturing equipment, and due to its inefficiency as an energy source, it can account for up to 10% of the total electricity consumption of a production site); and other manufacturing processes, such as cooling technology to remove heat from production processes and halls, soldering processes, and the use of PFCs and VOC based solvents (Mannhart et al. 2016).

In addition to environmental impacts, the manufacturing stage of ICT is also a site of social issues. Workers can be exposed to carcinogens and reproductive toxicants arising from the use of solvents, heavy metals and epoxy resins (EEA 2020a). Poor working conditions and human rights violations also frequently occur in the ICT supply chain, including in Malaysia, where issues such have forced labour have been identified, particularly further down the supply chain where monitoring and transparency is weaker (Ramchandani 2018).

Use: the use phase of ICT is responsible for the second largest share of global warming potential, contributing 31% of a desktop PCs THG100 and 14% of a laptops THG100 (Prakash et al. 2016). This is a product of energy consumption, so its true value may differ depending on the energy mix of the country in which the device is being used. While the electronics sector has generally witnessed an improvement in energy efficiency of electronic equipment over time, this is not necessarily the case in ICT, where devices are becoming more powerful as well as being more intensively used (The Shift Project 2019). In any case, even if a new laptop used 10% less energy than an old model, it would still need to remain in service for around 80 years in order to compensate for the energy consumed during the manufacturing stage (Prakash et al. 2016).

End of Life: in 2019, 53.6 million metric tonnes of waste from electrical and electronic equipment (WEEE or 'e-waste') were created, and less than 17.4% of this was properly collected and recycled. This figure varies drastically by region, ranging from 42.5% in Europe to 11.7% in Asia and just 0.9% in Africa (Forti et al.2020).

The improper management of e-waste can lead to environmental pollution and harm to human health due to the range of toxic substances contained within electronic products, including mercury, brominated flame retardants (BFR), chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HFCs). In addition, e-waste also contributes to global warming. For example, a total 98 MT of CO_2 equivalents were released into the atmosphere from discarded fridges and air-conditioners in 2019 (Forti et al. 2020).

The provision of new chargers and cables with each new device, or the use non-standard designs which require new chargers and cables, also creates unnecessary waste (as well as impacts during the manufacturing stage).

1.2 Improving the environmental impact of the ICT sector using a circular economy approach

The ICT supply chain typifies the waste and inefficiencies of a linear economy, in which valuable products and materials are lost from the economy as waste at the same time as new products and materials are produced using polluting and environmentally damaging processes. A transition to a circular economy is therefore required, i.e. an economy in which "[M]aterials are instead maintained in the economy, resources are shared, while waste and negative impacts are designed out" (Prakash et al. 2022).

According to (Prakash et al. 2022) strategies for achieving the goals of a Circular Economy include:

- Slowing down resource flows through the design of durable goods (e.g. multi-functionality, durability, modularity) and extending the product's lifetime (e.g. through repair, remanufacturing);
- Intensifying the use of products through measures, business models and practices that support different forms of sharing products (sharing) and concepts of the category „product-as-a-service". i.e. leasing;
- Reducing resource flows with the aim of using fewer resources per unit of product;
- Material substitution, for example with renewable raw materials, where appropriate, or replacing pollutants with more sustainable substances; and,
- Closing resource cycles through high-quality material recycling.

This transition will not happen without governmental intervention in markets. Low virgin material prices and high upfront investment costs in circular business models incentivise companies to continue with their business-as-usual linear approach (Kirchherr et al. 2017). For example, in the ICT sector, repairing and refurbishing devices is often expensive in comparison to buying new because raw materials are cheap, while labour is expensive. These market conditions are, however, the direct result of governmental regulatory and fiscal frameworks which choose to keep material and manufacturing costs artificially low by allowing the externalisation of environmental and social costs, or by directly subsidising environmentally harmful industries through tax breaks and investment. Unless governments address these perverse incentives, circular business models will struggle to achieve market share and meet their regenerative potential.

Some major consumer and producer economies have thus begun to develop comprehensive frameworks for a circular economy. Although still in a nascent phase, the scope of these policy frameworks, plus the size of the economies in question mean these policy developments will undoubtedly lead to changes in global ICT supply chain, and emerging economies with large manufacturing bases will need to react to these policy developments if they want to secure their future position within this highly economically productive sector.

The EU, in particular, has been a driving force of sustainability standards over the past decade. EU regulations such as the RoHS[2] Directive 2011/65/EU and the REACH[3] Regulation 1907/2006 have already restricted the use of certain chemicals and improved chemical reporting practices along global supply chains. Likewise, the Ecodesign Directive 2009/125/EC, which established a framework for setting minimum mandatory environmental requirements for energy-related products, has also been instrumental in driving the improvement of the energy efficiency of ICT products.

In 2015, the European Commission published its first Circular Economy Action Plan, and following the adoption of the EU Green Deal in December 2019 (which set out a roadmap for making the EU's economy sustainable) a second Circular Economy Action Plan was published in March 2020. The EU Green Deal and the Circular Economy Action Plan (2020) both identify ICT as a key product value chain requiring "urgent, comprehensive and coordinated actions". These include plans for new ecodesign requirements based on circular design principles, the implementation of a 'right to repair' for ICT products, regulatory measures on chargers[4], improved collection and treatment of e-waste, and a review of the restrictions of hazardous substances in EEE (European Commission 2020).

In March 2022, the first package of actions proposed in the action plan were adopted by the European Commission as part of the Sustainable Products Initiative (SPI). In addition to consumer empowerment measures (including new information requirements on the durability and repairability of products and strengthened protection against untrustworthy or false environmental claims), the SPI included a proposal for new Ecodesign for Sustainable Products Regulation which will extend the scope of ecodesign to focus more strongly on circularity aspects, including product durability, reusability, upgradability, repairability and recycled content, as well as maintaining its energy efficiency requirements. It will also introduce new information requirements for almost all categories of goods placed on the European market and proposes the creation of a 'Digital Product Passport'. This would function as an electronic record of product-related information, which

2 The restriction of the use of certain hazardous substances in electrical and electronic equipment

3 The registration, evaluation, authorisation and restriction of chemicals

4 Since implemented in Directive (EU) 2022/2389 as part of the EU common charger initiative

could be shared easily along the supply chain, as well as with authorities and consumers. The goal of this would be to increase the transparency of product related information (European Commission 2022).

In addition to these design-focused measures, the EU also has policies focused on the downstream of electronic waste. In particular, the WEEE[5] Directive 2012/19/EU introduced an Extended Producer Responsibility (EPR) scheme. This requires manufacturers, distributors or sellers of EEE products to organise or finance the collection, treatment, recycling and recovery of products sold in the EU market. EPR schemes have also been implemented in a number of other countries, including Australia, Canada, China, South Korea and the USA (at a state level). The overall objective of EPR schemes is to shift the cost of waste management away from local authorities and the general taxpayer to the producers who are responsible for the initial creation of the waste.

Finally, EU policies also seek to incentivise demand for circular products, for example, Directive 2014/24/EU already allows the inclusion of environmental criteria in public procurement, and many public authorities in the EU are now integrating circular requirements into their ICT tenders. The Circular Economy Action Plan (2020) signalled the intention to introduce minimum mandatory green public procurement (GPP) criteria in upcoming sectoral legislation.

In addition to increasing institutional demand, governments can also introduce policies which increase consumer awareness, such as the creation consumer information labels, such as the French Government's recently introduced repairability index which came into force in January 2021[6] for five product types (including laptops and smartphones, and from 2022 onwards, tablets) and the repairability scores awarded by iFixIt. The French Repairability Index requires producers, importers or distributors of laptops to assess the repairability of their products, and for sellers to communicate this score to consumers at the time of purchase. By 2024, it is foreseen that the focus of the index will be extended to cover durability. Spain has since announced its intention to implement a similar repairability score, while the European Commission's JRC has already prepared a first draft of a European repair scoring system for smartphones and tablets (Hop 2022).

Independent, third-party certified ecolabels can also provide reliable certification of a product's green credentials. Some of these labels are directly supported by the state, such as the Blue Angel label in Germany or the China Environmental Labelling Programme (CELP). In the ICT sector, the international TCO Certified label is also an influential and credible certification for sustainable ICT. Labels such as TCO Certified have already began incorporating circular design requirements (such as durability, battery longevity, and product repairability) into their specifications, alongside other requirements on socially responsible manufacturing, user health and safety, use of hazardous substances and energy efficiency. As of December 2022, almost 4000 models of ICT devices meeting TCO Certified requirements are available on the market, demonstrating a significant market uptake of these standards (TCO Certified).

On the supply-side, China – which is responsible for almost 40% of the world's output of electronics (Ellen Macarthur Foundation 2018b) – is also introducing

5 Waste of Electrical and Electronic Equipment

6 Article 16 of law of 10 February 2020 against waste and for the circular economy (AGEC)

measures to transform its own industrial sectors. China has already had a Circular Economy Promotion Law in place since 2009 with the aim of raising resource utilization rate, protecting and improving the environment and realising sustained development. Its National Development and Reform Commission also recently reinforced circular economy as a national priority in the 14th Five-Year Plan period (2021-2025), which is especially targeted at manufacturers that use resources for production and create waste. Measures target the length of product lifecycles, including promoting the green design of products and promoting the development of a remanufacturing sector (Chipman Koty 2021).

The rest of this section will focus on specific design and manufacturing processes which supply chain actors can implement to directly facilitate a more circular ICT value chain, and the policies and practices which are driving transition in the sector. This understanding of current practice is based on desk research supplemented expert interviews with two major OEMs, one innovative market entrant specialised in repairable devices, one ICT certification body, and a review of the sustainability reports of the 15 major ICT brands/ OEMs and CMs.

1.2.1 Design for durability

As detailed in section 1.1, key environmental hotspots in the ICT lifecycle include the manufacturing phase and the generation of waste at the end of devices' product lifetime. These problems are exacerbated by the short product lifetimes of electronic products. With many ICT products lasting far below their optimal lifetime (i.e. the length of time taken to achieve the optimal environmental, social and economic impact). Laptops for instance are typically replaced every 4.5 years but have an optimal lifetime of 20 to 44 years. For smartphones the difference is even starker: devices are typically replaced every 3 years, however, their optimal lifetime has been calculated to be between 25 and 232 years.

Even comparatively small gains in lifetimes can yield large environmental benefits. For example, a 1-year extension of all notebooks in the EU would save 1.6MT CO_2 per year by 2030 (the equivalent to taking 870,000 cars off the road). A five-year extension would add up to around 5 Mt of CO_2. Likewise, a 1-year extension of all smartphones in the EU has been estimated to save 2.1 Mt CO_2 per year by 2030 (the equivalent of over 1 million cars off the road), growing to 5.5 Mt CO_2 for a 5-year extension (EEB 2019). As a general rule, doubling a product's lifespan will halve the products environmental impact, even in the electronics sector where new products may offer higher energy efficiency (Oeko-Institut 2018). For this reason, increasing the longevity of devices can be considered one of the most effective ways to reduce their environmental impact.

Reasons for short product lifetimes (otherwise known as 'product obsolescence' can vary). The EEA (EEA 2020b) has defined two broad categories: absolute obsolescence, or the failure of a product to function due to mechanical failures of components or materials or software and/or hardware interoperability issues, and relative obsolescence, which describes when still functional products are no longer used. Of these two, the only the former is purely determined by design, while the latter is the result of wider factors influencing consumer decisions to upgrade, of which design is just one.

The longevity of devices – particularly portable devices – can be improved by making sure they can withstand the conditions of daily life, including being dropped, getting accidentally wet, or being subject to cold or hot weather. Standards and test methods have already been defined, including for drops (IEC 60068 Part 2-31: Ec (Freefall, procedure 1)), temperature stresses (IEC 60068 Part 2-1: A Cold and Part 2-2: B Dry Heat), and protection against water and dust (IEC 60529:2013) (Alfieri et al. 2021).

It should however be noted that trade-offs between durability and other aspects of circular design (i.e. repairability - as discussed in section 1.2.2) exist, as constructing devices to be more durable and/or waterproof may require increasing the integration of components (for example, gluing components together to make them more resistant to being dropped) (Clemm et al. 2019). Practical solutions to durability could include testing devices within protective cases. This makes particular sense in the case of smartphones, where most users keep their device in some form of case.

In practice, three major ICT brands mention implementing measures which aim to increase the durability of their products in their sustainability reports. If a measure is not mentioned by a brand, it is assumed it is not a current priority. HP, for example, uses the US military MIL.STD.810G standard for testing some product lines (HP 2021), while Oppo and Samsung also both stated that tests are conducted (without specifying which standards are used) (Oppo 2021; Samsung 2022).

Finally, battery durability is also a major determining factor in the lifetime of portable devices. Batteries degrade over time and are a problematic source of waste. Most smartphones have built-in batteries which typically only last two years[7] and are difficult or expensive to replace (EEA 2020b). If a battery cannot be replaced (for example, because it is glued in place) then the whole device must be disposed.

In practice, three major companies are already working to extend battery lifetimes. For example, Lenovo states that it has begun working with a battery manufacturer to increase battery lifetime from 800 cycles to 1200 cycles (Lenovo Group Limited 2022). More brands/ OEMS will likely also already or soon require their suppliers to improve the performance of batteries they manufacture, in line with the proposed EU Ecodesign regulation for smartphones and tables, which states that batteries must be removable or must retain 80% of its full charge capacity after 1000 cycles (Spiliotopoulos et al. 2022)

1.2.2 Design for disassembly

Disassembly is a key enabler of three different product lifetime extension strategies: repair, refurbishment and remanufacturing. Repair refers to restoring the functionality of damaged devices for the original owner, while refurbishment refers to restoring or improving the functionality of a device (damaged or undamaged) for the purpose of resale. Remanufacturing is similar to refurbishment, however, it is more focused on the component level (i.e. the collection and refurbishment of components for reuse in new products) (IPR 2018).

7 i.e. retain 80% of their capacity after 500 charge cycles (EEA 2020)

Table 1-1 Difference between repair, refurbishment and remanufacturing (IPR, 2018)

CIRCULAR ECONOMY STRATEGY	DEFINITION (IPR 2018)	RESULT
Repair	Fixing a fault or replacing defective components, in order to make a product fully functional again.	Functionality of device restored by/on behalf of device owner
Refurbishment	Modifying a product in order to increase or restore its original performance or functionality, or to meet new technical standards or regulatory requirements.	Functionality of device restored to defined standards for the purpose of resale
Remanufacturing	An industrial process which takes place within a factory setting, in which products or components are restored to the same condition as a new product, or better (and are subject to the same quality testing and warranty conditions as a new product).	Components harvested from a device and their functionality restored to defined standards, for the purpose of reuse in a new product

Definitions based on (IPR 2018)

According to their sustainability reports, four major brands/OEMs are already implementing design for disassembly strategies, including standardising components, using modular design, using screws and fasteners instead of adhesives to join components, and enabling disassembly through standardised design (Acer 2021; Dell 2022; HP 2021; Oppo 2021).

1.2.2.1 Repair

ICT products are complex devices which are subject to heavy use and accidental damage (for example through drops or exposure to water). One study of 800 organisations in the US found that 11% of notebooks used by staff fail within their first year of use, increasing to 20% by year five. This means that in a five-year period, 61% of notebooks required some form of repair (Mainelli 2016).

Repair is often difficult due to the way devices have been designed. For example, laptops are difficult to repair due to the continuous miniaturisation of devices and components, as well as an increase in the use of welding and glue to hold products together (Hop 2022). Instead of permeant fixings – like welds and glues – fasteners allow parts to be easily removed. The number, type and visibility of fasteners can also influence the ease of repairability (Spiliotopoulos et al. 2022).

Another element of repairability is the ability to carry out repairs with standard tools. If a repair requires specialised tools, at-home repair is prevented, the accessibility of repair services is reduced, and the cost of repairs is increased. For this reason, repairs should be possible either with no tools, or using basic tools as defined by standard EN 45554:2020. Where this is not feasible, specific tools could also be supplied along with the product or the spare part (Spiliotopoulos et al. 2022).

Finally, in order to be able to repair a device, spare parts must be available, in particular those most likely to fail, including: batteries; display assemblies; chargers; back covers or back cover assemblies; front-facing camera assemblies; rear-facing camera assemblies; external audio connectors; external charging ports; mechanical buttons; microphones; speakers; hinge assemblies; and mechanical display folding mechanisms (Spiliotopoulos et al. 2022).

A new ecodesign regulation will widen the scope of minimum requirements for products introduced onto the European market to include repairability. Developments in this direction can already be seen in the latest ecodesign regulation on electronic displays (Regulation No 2019/2021) which includes several repairability measures, including that spare parts must be available to professional repairers and/or end users for a minimum of seven years after placing the last unit of the model on the market. It is also required that these spare parts shall be available free of charge and can be replaced with commonly available tools. In addition, in December 2022, a provisional agreement was reached by the European Parliament and Council to update the EU Batteries Directive, including a requirement that portable batteries in appliances must be designed so that consumers can easily remove and replace them themselves (to enter into force three and a half years after the introduction of the legislation).

The USA has also been moving in the same policy direction, and has instigated a new ‘right to repair’, which will limit manufacturers ability to bar self-repair or third party repairs of their products (The White House 2021). This has been instigated as part of Executive Order 14036 on Promoting Competition in the American Economy. Section 5 (h) on addressing persistent and recurrent practices that inhibit competition, part ii addresses “unfair anticompetitive restrictions on third-party repair or self-repair of items”. In addition, around 10 state bills on the right to repair are currently in progress in the USA.

Also relevant to repairability is the development of repairability scores, which aim to inform consumers about the repairability of devices available on the market. Some brands/OEMs have acknowledged their repairability scores and signalled an intention to improve these scores for certain devices. For example, HP made reference to the iFixit product repair score (HP 2021), while Samsung and Xiaomi referred to product scores against the French repairability index (Samsung 2022; Xiaomi Corporation 2020).

However, as already mentioned in section 1.2.1, a trade-off may exist between the repairability of a device and its durability. Similarly, more repairable devices may also require more material than devices which use permanent fixing. For example, reversibly joined components require more copper and gold for electrical connections between components than permanently joined components. This can result in higher environmental impact during the production phase. However, if the repairability of the device does indeed lead to a lifetime extension, then it is still likely that the repairable device will achieve a significantly lower total life cycle impact than the marginally more efficient but unrepairable device (Clemm et al. 2019).

1.2.2.2 Refurbishment

Refurbishment allows used devices to be prepared for resale, which extends the overall lifetime of the product by cycling them away from waste and back into a second use phase. Refurbished devices can be cheaper than new products, which can be attractive to some consumers, both private and institutional.

The design decisions which enable repair – discussed above – also determine the devices suitability for refurbishment. Unlike repair, which can be undertaken by individuals, refurbishment is a process best led by specialised companies with the technical ability to restore products to defined standards, meaning that refurbished products can be sold with the assurance and warranties required to inspire consumer confidence in the product.

One barrier to refurbishment is the lack of standardisation and cross-compatibility between makes and models of ICT device. This is also being tackled at a policy-level in Europe. In October 2022, the European Council for example approved a new Common Charger Directive, which will require a range of electronic devices (including mobile phones, tablets and e-readers, digital cameras and video game consoles, headphones, earbuds and portable speakers, wireless mice and keyboards, and portable navigation systems) on the European market to use a USB-C port from 2024 onwards. In addition, all laptops will also be covered by the Directive 40 months following its entry into force. The goal of this initiative is to increase compatibility and reduce electronic waste resulting from chargers (Council of the EU 24 Oct 2022).

Another barrier to refurbishment at scale is the fact that it remains a largely manual process, meaning there is a comparable difference in its efficiency compared to manufacturing new products. Investments in automation and the implementation of industrial-scale batch refurbishing could help improve the competitiveness of this sector (Ellen Macarthur Foundation 2018a).

Several major brands/OEMs have developed return logistic systems to capture devices at the end of their product lifetime, and several have recognised the potential of refurbishment. However, it is difficult to determine how much – if any – of the collected devices are currently being reused (as opposed to being sent to recycling). One company which did disclose figures was Lenovo, which stated that out of the 34,163 metric tonnes of collected equipment in 2021, only 5.5% was reused as products or parts, while 88.2% was recycled as materials[8] (Lenovo Group Limited 2022).

One of the brands interviewed as part of this study has a consumer and commercial takeback scheme in place in some markets. The goal of this scheme is to sanitise returned devices and assess their value for resale in outlets. Unlike the global value chain for new products, products are collected, refurbished and resold at a regional level (for example, at a European scale). Presently, the small size of the

8 Of the remaining, 1.5% was sent to energy recovery, 2.1% was incinerated without energy recovery, and 2.6% was disposed to landfill.

resale market in comparison to the market for new products means it largely operates separately, with its key customers being cost-conscious public and private organisations. In time, however, the resale market may increasingly erode the market for new products. The growth of this refurbishment market is being actively promoted in some jurisdictions, for example in France, where it is now required that at least 20% of office ICT results from reuse or recycling, while a further 20% must incorporate recycled materials[9].

1.2.2.3 Remanufacturing

It may not always be possible to return a device to its original condition (for example due to the failure of specific components, or it may not be attractive to do so (for example due to technological change meaning the original device is no longer desirable). This does not mean, however, that all of the components of the device have lost their function, and remanufacturing processes can be used for the selective reuse of components in new devices. For example, just because a device's memory no longer meets expected performance levels, the LED screen specs may still meet consumer expectations, meaning the screen could find reuse. In addition, the fast pace of technological development in the ICT sector means there are also opportunities to reuse functional components from end-of-life devices in less demanding applications (for example, cascading flash memory from smartphones for reuse in USB sticks) (Clemm et al. 2019).

One major CM – Flex – is already integrating some level of remanufacturing into its operations, including returns management, testing and refurbishment. It stated that by using refurbished products, it saves 7,000 metric tonnes of CO_2 per year from its operations (flex 2022). HP is also tracking how many tonnes of products and parts are being reused (7,200 in 2021, or 0.8% of total material use) (HP 2021), and Lenovo has set a target that at least 76% of its repairable parts will be repaired for future use by 2025/26 (Lenovo Group Limited 2022).

1.2.3 Recycling

In line with the waste hierarchy, recycling of ICT falls lower in the hierarchy of desirability after prevention, reuse and repair, with materials being inevitably lost during the collection, pre-treatment and final treatment stages. Nevertheless, better recycling of ICT is still more desirable than incineration or landfill and remains a practical necessity for managing waste. Recovered materials can also be used to replace the demand for virgin resources.

Several materials in ICT products can be recovered at the end of life, including metals and minerals, glass from LCD screens, and aluminium alloys and plastics from casing (Alfieri et al. 2021). As mentioned in 1.2.2, the ability to take apart a product easily is one factor in facilitating the recycling of materials at the end of the product's lifetime. However, other design choices can also support recycling, such as material choice.

For example, a current barrier to recycling plastics from ICT devices is the use of materials which are not recyclable – either from a technical or economic point of

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9 Décret n° 2021-254 du 9 mars 2021 relatif à l'obligation d'acquisition par la commande publique de biens issus du réemploi ou de la réutilisation ou intégrant des matières recycles (https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000043231546)

view. This includes polymers reinforced with glass fibres and carbon fibres (Clemm et al. 2019). To improve the recycling of plastics from ICT, larger plastic pieces (i.e. over 25 grams) should be marked according to ISO's 'Generic identification and marking of plastic products' (ISO 11469) and 'Plastics – Symbols and abbreviated terms' (ISO 1043 Part 1 and 4). Plastics should also not be painted, coated or finished with anything that is incompatible with recycling (as defined by ISO 180:2019) (Alfieri et al. 2021).

Likewise, batteries come in many forms, and recycling processes rely on the manual sorting of batteries according to their different chemistries. Better labelling of batteries can improve this sorting process (Alfieri et al. 2021). The provisional agreement reached by the European Parliament and Council in December 2022 to update the EU Batteries Directive also foresees a requirement that new batteries must include minimum levels of recovered cobalt (16%), lead (85%), lithium (6%) and nickel (6%) (European Parliament 19 Dec 2022), thus helping to establish demand for recycled materials.

In terms of metals, some valuable metals such as copper, cobalt and gallium are recovered where technically possible due to the high demand and price of these materials (Clemm et al. 2019). However, many metals are only present in very small quantities, making it difficult to recapture them. A smartphone, for example, can contain up to 60 different elements on the periodic table (EEA 2020b). While recycling processes do exist for some of these materials (like magnesium, tungsten, some rare earths and tantalum), these processes require a pure input material, meaning ICT devices are not an attractive source from an economic perspective (Mannhart et al. 2016). Recycling technologies are developing, however, including electrochemical and hydrometallurgy processes, as well as developments in the traditional pyrometallurgy processes (Ellen Macarthur Foundation 2018a). This means new opportunities for recycling future waste (as well as mining existing waste) may emerge in medium-term.

Finally, recycling can also be influenced from the demand-side i.e. by using recycled materials, manufacturers can incentivise further investment in the recycling sector. Not all recycled materials are alike, however, when it comes to performance. For example, one interviewee stated that it is more difficult to achieve consistent performance specifications when working with recycled polymers compared to new. Another challenge of using recycled polymers from post-consumer plastics is the potential presence of hazardous or even banned materials which can be found in historic waste. Although such polymers do not violate the thresholds set by regulations (like the RoHS Directive which is defined on the bases that no hazard substance is intentionally added) they do fail to meet "halogen-free" requirements which are often demanded by industrial or institutional buyers (Clemm et al. 2019).

In practice, the use of recycled materials is the most commonly practiced circular design measure identified among brands and OEMs (referenced in eight of the sustainability reports analysed). Many are already offering products made in part with post-consumer recycled (PCR) materials, and several also have targets to increase this in coming years. For example, Acer has the goal that 20-30% of plastics in their notebooks, desktops and monitors will come from PCR by 2025 (Acer 2021), Dell aims that over half of product content will come from recycled or renewable material by 2030 (Dell 2022), and Lenovo aims that PCC plastics will be included in 100% of its notebooks, desktops, workstations and monitors by 2025/26 (Lenovo Group Limited 2022). In addition to plastics, recycled metals can also be used in new products. Apple, for example, has identified 14 priority materials, including aluminium, cobalt, copper, gold, lithium, rare earth elements, steel, tantalum, tin and zinc. Glass has also been identified by Apple as a priority for recycling (Apple 2022b).

To achieve these targets, a huge volume of recycled materials will be required, including the transboundary movement of end-of-life products (Yamaguchi 2022). As one brand interviewee explained, however, it is challenging to get material from where it is collected to where it needs to be reprocessed. This is partly due to regulations on the transboundary movements of waste, including the plastic waste amendments to the Basel Convention which have been in force since January 2021 (as well as the e-waste amendment due to enter into force in January 2025) (Yamaguchi 2022). Although providing an essential international framework to control waste shipments and dumping, the Prior Informed Consent (PIC) procedure required by the Basel Convention can also present a barrier to recycling, for example, due to the cost and time sometimes involved in applying for notifications and gaining approval from transit nations (PREVENT Waste Alliance & STEP 2022).

As a result, one interviewee explained that the most viable opportunities for increasing the use of recycled content are in China, due to the combination of large-scale collection and manufacturing capabilities.

China has been actively facilitating these exchanges, and its 14th Five-Year Plan (2021-2025) outlines measures focused on improving recycling such as strengthening the utilization of waste (including electrical waste and electronic products), standardising recycling processes for various products (including electronics), improving the recycling of used batteries, improving the processing and utilisation of renewable resources, and increasing regulatory supervision. China has also placed restrictions on waste imports into the country via its 'Green Sword' policy, which took effect on the 1st January 2018. The goal of this policy was to reduce the volume of waste imports and to improve the quality of imports (i.e. less contamination in recyclable imports). To this end, 24 types of recyclables have been banned including waste plastics (Chipman Koty 2021)..

Another barrier to the sourcing of recycled materials is cost. If manufacturers are required to import recycled materials, the extra shipping involved will result in extra costs. This highlights again the importance of regional collection of ICT waste.

The ability to source high quality recycled materials will therefore become increasingly important for supply chain actors. As Lenovo explains, this will include requirements to validate the sources of waste and control processes using traceability schemes (Lenovo Group Limited 2022). One of the interviewed brands also referenced the importance of third-party certification, stating that suppliers have already achieved this for over half of the recycled materials used in products.
At least two brands/OEMs make use of the UL Environmental Claim Validation Procedure for Recycled Content (UL 2809) [10], which validates the amount of recycled content contained in a product (HP 2021) (Acer 2021). In addition, Apple's Environmental Progress Report states that all recycled content claims used in their products have been verified by an independent third party according to recycled contents conforming with ISO 14021 (Apple 2022a).

10 https://www.ul.com/services/recycled-content-validation

2 ICT Sector in Malaysia

According to the Malaysia Productivity Corporation (MPC), the EEE subsector is the backbone of Malaysia's economy (Malaysia Productivity Commission 2022). It has also been identified in the Twelfth Five-Year Plan as significant high-impact industry (Malaysian Government 2022). In 2021, the export earnings from the EEE industry were RM455.73 billion, or 36.8% of total exports. Although this is a slight fall on the 2019 figure (RM372.67 billion) it still remains the main contributor to overall export earnings in Malaysia (Department of Statistics Malaysia).

According to the Malaysia Investment Development Authority (MIDA), the EEE industry in Malaysia started in 1970 with only eight companies producing simple components, semiconductor parts assembly and SKD electrical parts. Today, this sector has widened to include sensors, internet of things, cloud computing, wireless electronics, nano technology, SMART electronics, 3D integration, Smart grid, advanced energy, storage, Fablite, Fabless, Miniaturisation, and electric vehicle (EV) competencies (MIDA 2021).

Four classes of the EEE sector are especially relevant to ICT value chains: electronic components and boards (261); computers and peripheral equipment (262), communication equipment (263) and the consumer electronics (264)[11]. According to the Malaysian Department of Statistics, the largest of these subcategories is electronic components and boards, and in 2017, 533 companies existed in this sector (up from 509 in 2015). Computers and peripheral equipment, consumer electronics and communication are each around one-fifth of this size (116, 106 and 80 companies existed in 2017 respectively), as shown in Figure 21.

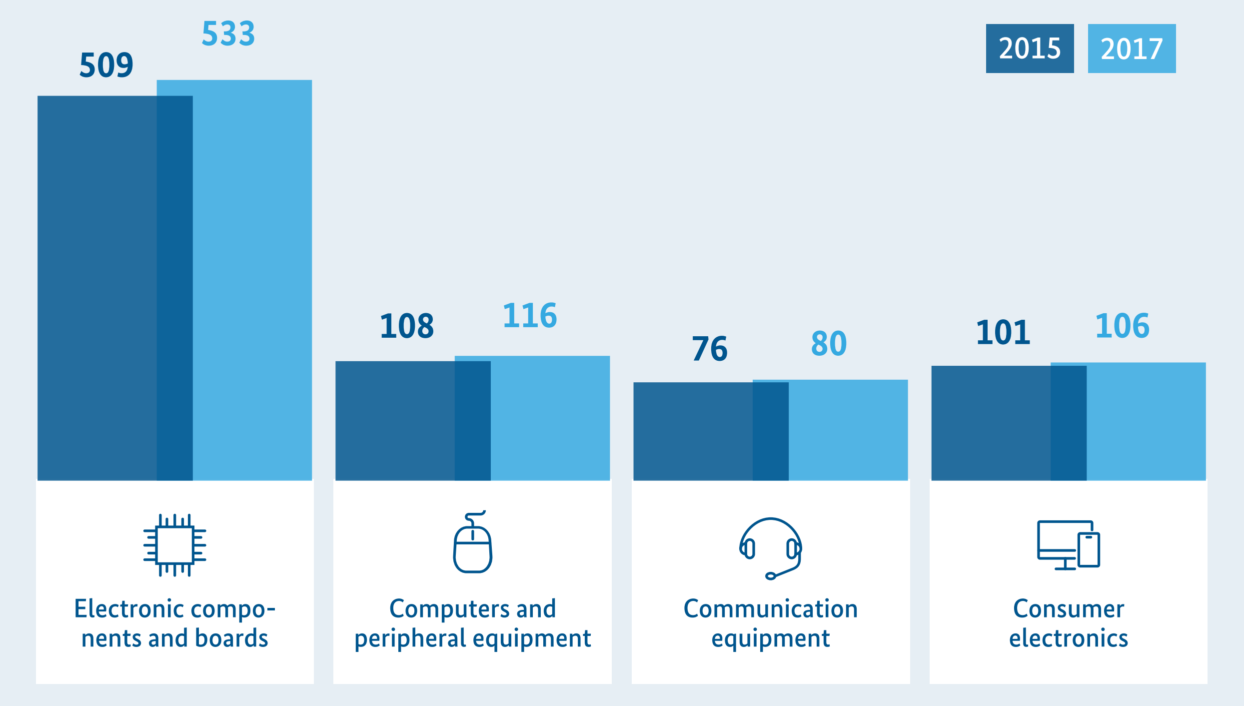

Figure 2-1 Number of EEE Companies by Subsector 2015 & 2017

Source: Department of Statistic, Malaysia | Own illustration

11 Numbers represent the code allocated by the three-digit Malaysia Standard Industrial Classification (MISC) system,

In terms of geographic location, the Middle region (Negeri Sembilan, Selangor and Melaka) is home to a slightly higher concentration of factories across all subsectors than the Northern (Pulau Pinang, Perak and Kedah) and Southern (Johor) regions, although all subsectors are present in each. The East Coast region (Terengganu and Kelantan), on the other hand, is only home to 8 electronic component and board factories. An overview of the geographic distribution of factories is provided in Figure 22. East Malaysia (Sarawak) also has a negligible industrial presence and is not included in the graph.

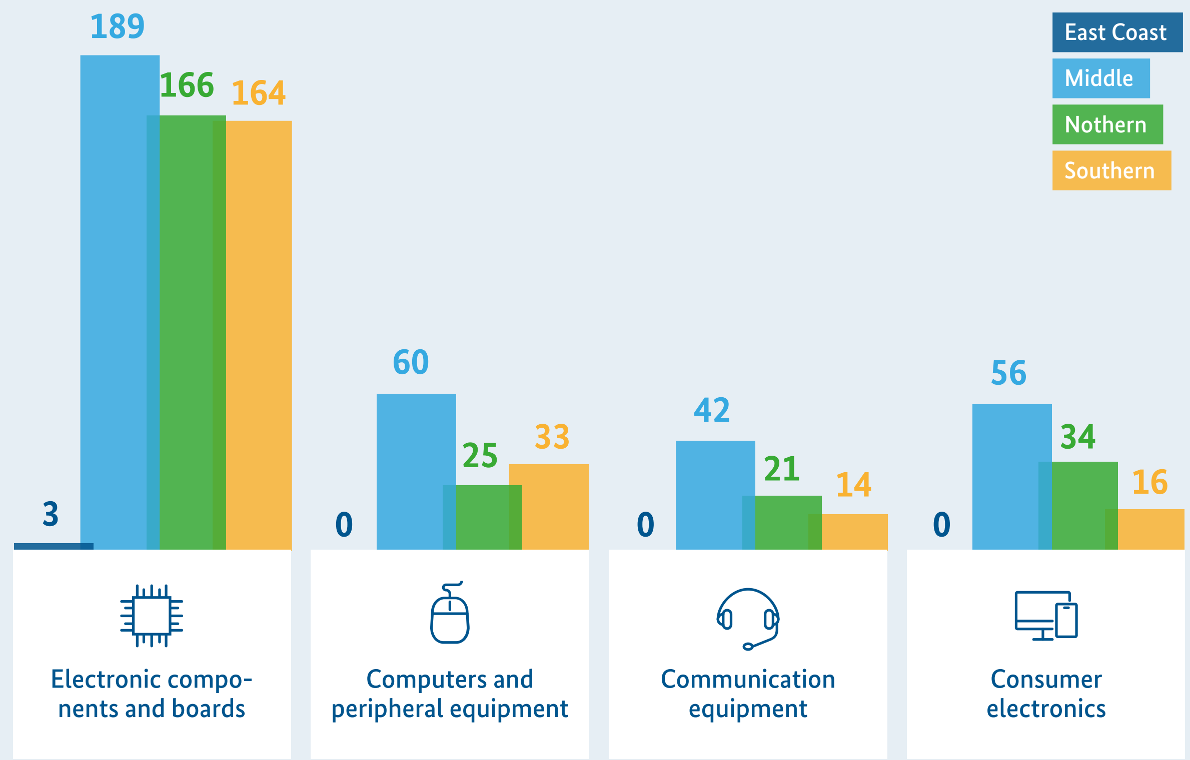

Figure 2-2 Number of companies by region, 2017

Source: Department of Statistic, Malaysia | Own illustration

These ICT subsectors are significant sources of employment, with around 200,000 people working in the electronic components and boards subsector alone. Overall, over 315,000 people are employed across these four subsectors (which accounts for around 53% of employment in the EEE industry as a whole). Between 2015 and 2017, the number of people employed in electronic components and boards and the consumer electronics subsectors increased, while the numbers in computers and peripheral equipment and communication equipment fell, as shown in Figure 23.

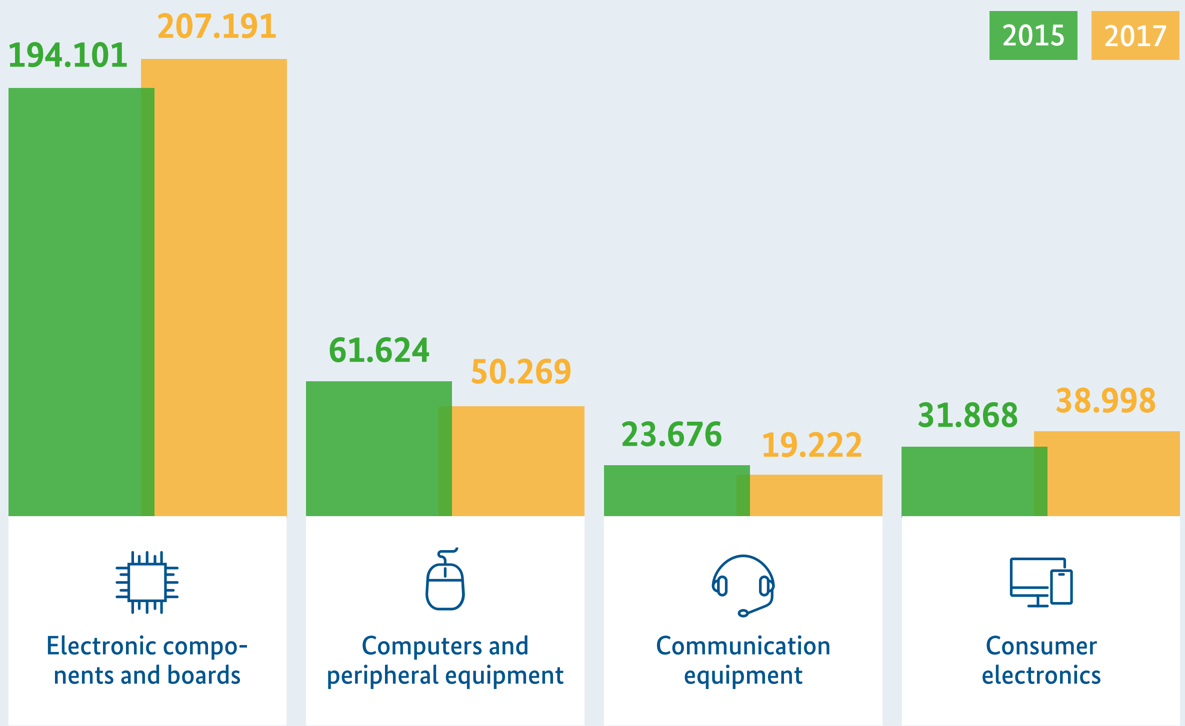

Figure 2-3 Employment according to EEE Subsector

Source: Department of Statistic, Malaysia | Own illustration

2.1 Current circular economy policy initiatives in Malaysia

In the country's Twelfth Five-Year Plan, the Malaysian Government has already identified transitioning to the circular economy as necessary under "advancing green growth for sustainability and resilience" (Strategy A2). Strategies include incorporating ecodesign requirements into relevant policies and legislation, including setting new benchmarks for recycled content criteria. Plans to implement an EPR scheme for household electrical and electronic waste (e-waste) via new regulation are also set out (Malaysian Government 2021).

In addition, a new target for 25% green procurement has been set (building on the target of 20% set in the set in the Eleventh Five-Year Plan), and between 2016 and 2019, the average proportion of total government procurement for selected green products and services was 20.7%. In addition, the Twelfth Plan seeks to expand GPP initiatives from central government ministries to also include state governments and local authorities (Malaysian Government 2021). In line with this, the Ministry of Finance published a new circular on public procurement on 29th of November 2022, which has made green procurement for 100% of purchases in selected product groups, including ICT equipment, as well as other electrical equipment (such as televisions, fans, freezers and washing machines) (Malaysian Government 2022).

Strengthening Waste Management is also already recognised as a policy priority in the Twelfth Five-Year Plan. This includes enhancing collection, separation and recycling facilities (Malaysian Government 2021). However, the e-waste recycling rate in Malaysia is currently under 25%, and existing licensed e-waste recovery facilities reportedly prefer to only collect e-waste from large companies or factories as this is more profitable than collection of consumer e-waste (Netherlands Enterprise Agency 2021).

Finally, Malaysia has already introduced tax incentives to encourage investment in green technologies and to enhance the number of green technology service providers via the Green Investment Tax Allowance (GITA) scheme for the purchase of green technology assets and the Green Income Tax Exemption (GITE) scheme on the use of green technology services. Currently, applicants can claim GITA on investments in renewable energy, energy efficiency, green buildings, green data centres and integrated waste management. For GITE, services (such as design, feasibility studies, advising/consulting, auditing, testing and commissioning) related to renewable energy, energy efficiency, electric vehicles, green buildings, green data centres, green certification and verification, and green townships (i.e. low carbon city planning) are currently eligible (MGTC 2022). Thus, financial support is available for some investments relevant to the circular economy (such as use of renewable energy and access to green certification), however, investments in circular design are not currently directly eligible.

3 Circular economy awareness and practice in Malaysia's ICT subsectors

3.1 Survey background

In December 2022, a survey of 25 companies across Malaysia's ICT subsectors was conducted. As shown in Figure 31 most respondents (36%) came from the Electronic Components and Boards subsector, followed by Computers and Peripheral Equipment (30%), Communication Equipment (18%) and Consumer Electronics (16%). Regarding company size, 76% of the respondents have more than 500 workers (Figure 32).

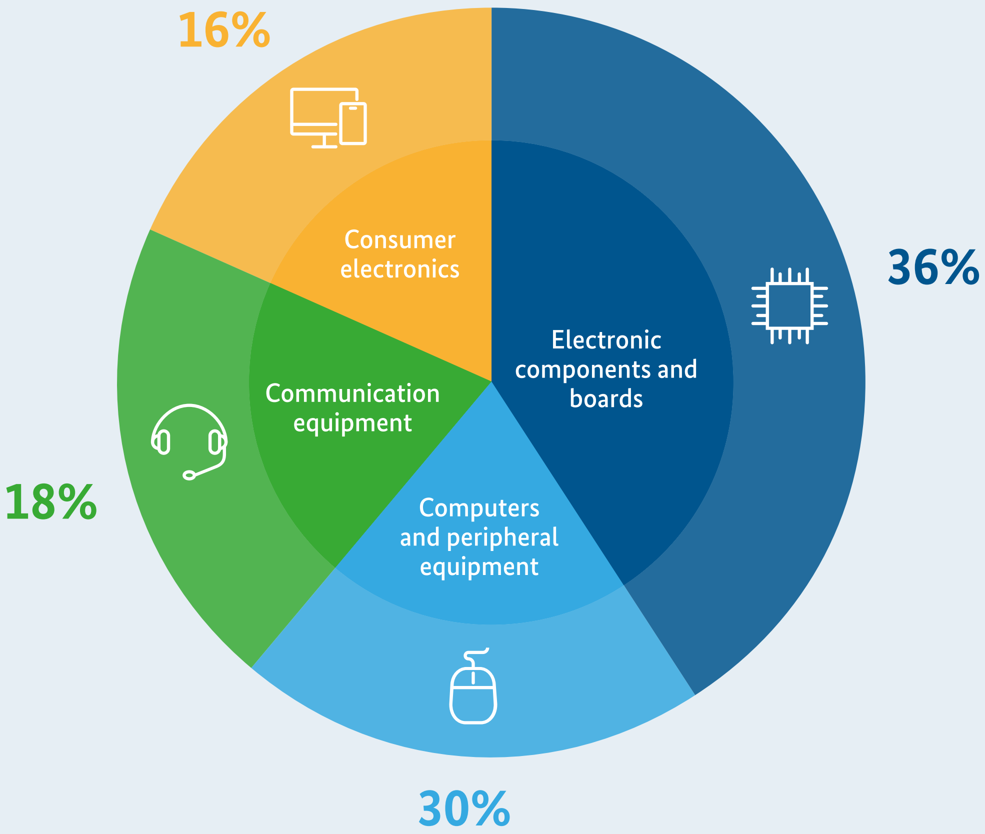

Figure 3-1 Subsector of survey respondents

Source: Own illustration

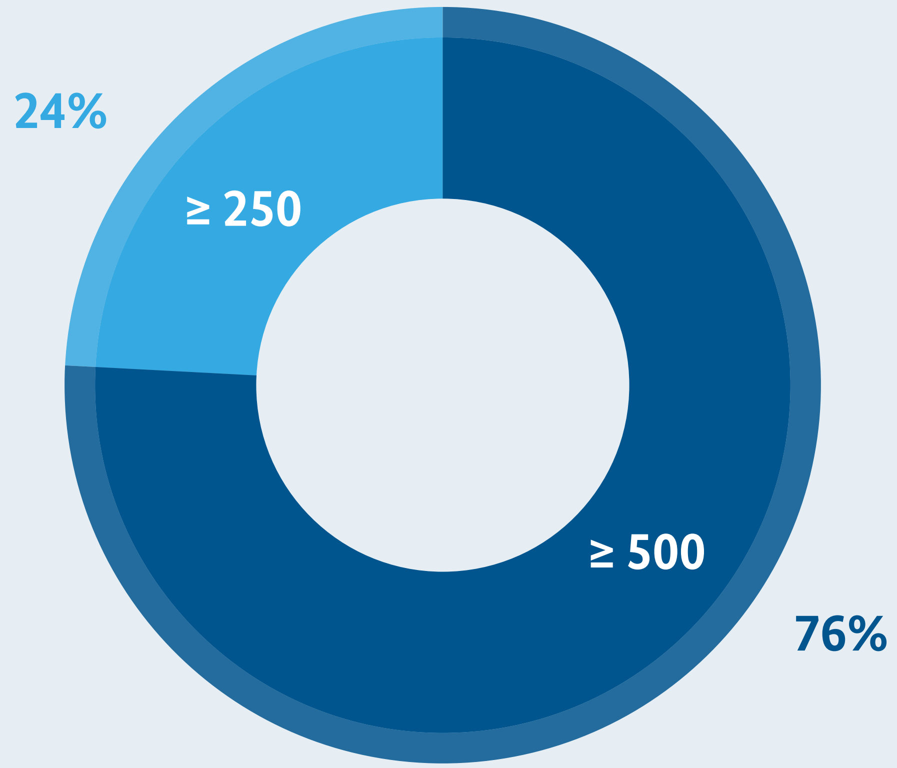

Figure 3-2 Number of employees of survey respondents

Source: Own illustration

Figure 33 shows the region in which the companies of the 25 respondents are based. Overall, 40% are based in the northern region and central region respectively (10 respondents each), while the remaining 20% (5) are based in the southern region. No companies with operations in the east coast region and east Malaysia responded to the survey, which is not surprising given the lower concentration of factories in these regions.

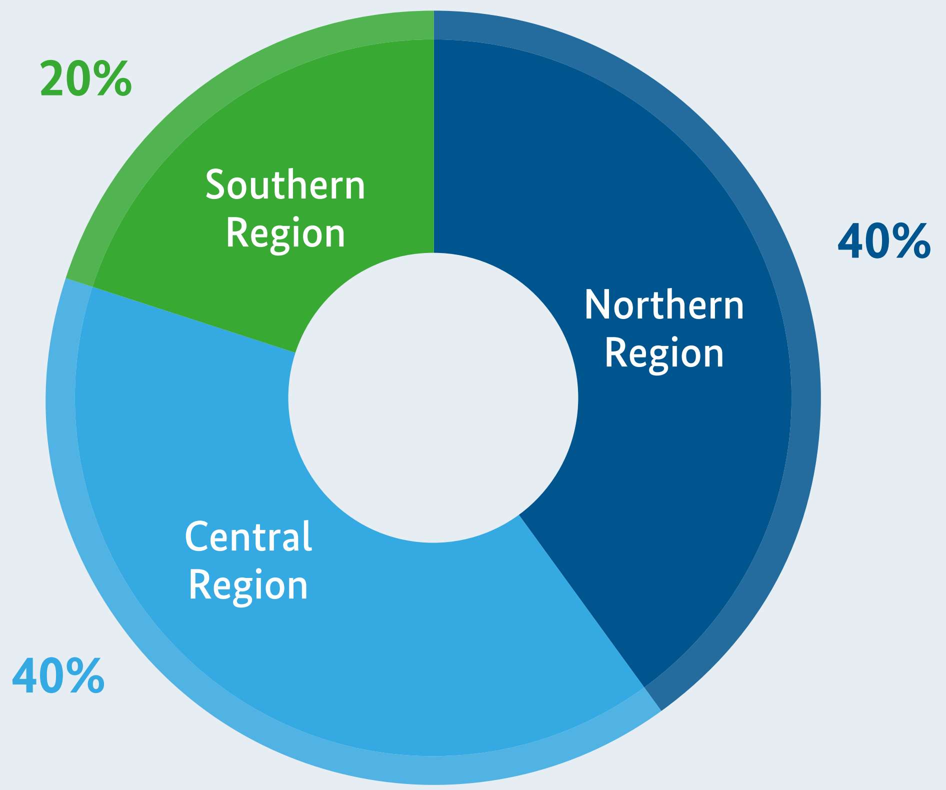

Figure 3-3 Location of survey respondents

Source: Own illustration

In terms of the major markets for companies' products, 25% export to Europe and 23% to North America. China is also a major market for 18% of respondents. Finally, 23% of respondents also serve customers in Malaysia (Figure 34).

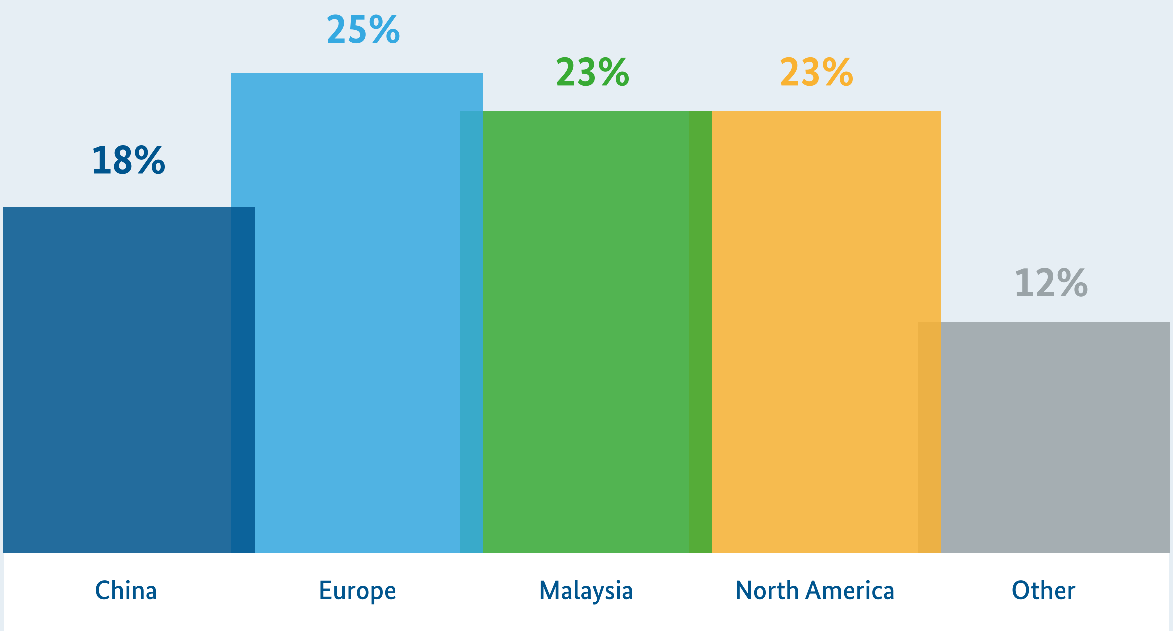

Figure 3-4 Major markets for survey respondent's products

Source: Own illustration

The survey findings were also supplemented by interviews with representatives from 14 further companies, 60% of which worked with multinational companies based in the USA or Europe, while the other 40% worked with local companies listed in the Bursa Malaysia (KLSE). Interviewees were sourced from across the four ICT subsectors. All companies interviewed have more than 500 employees, and some of them have more than one location in Malaysia. Most export globally, although three concentrate on the Malaysian market and its surrounding countries.

3.2 Current sustainability and circular economy practices of the Malaysian ICT subsector

Respondents were asked to report their current sustainability and circular economy practices (Figure 35). Overall, none of the provided practices scored highly. For example, the most common - zero waste measures – was reported by less than one-fifth of respondents (18%). On the other hand, all interviewees claimed to implement waste reduction strategies, even if the goal of zero waste has not yet been met. Most of the reported practices related to office processes, such as paperless meetings. However, one interviewee claimed that 100% of the packaging material of their products is also recycled.

In terms of designing products suitable for a circular economy, 13% reported manufacturing products to higher durability and/or longevity standards. During the interviews, this rate was higher, with over half of respondents claiming that their products are made to higher durability standards, in part to meet the standards set by their export markets.

In addition, 12% stated that they are manufacturing products which are easy to repair, although only 7% reported making products which are easy to dismantle. During the interviews, one computer-related product manufacturer confirmed that they are actively working to improve the repairability of their product by making it easier to disassemble and to replace parts.

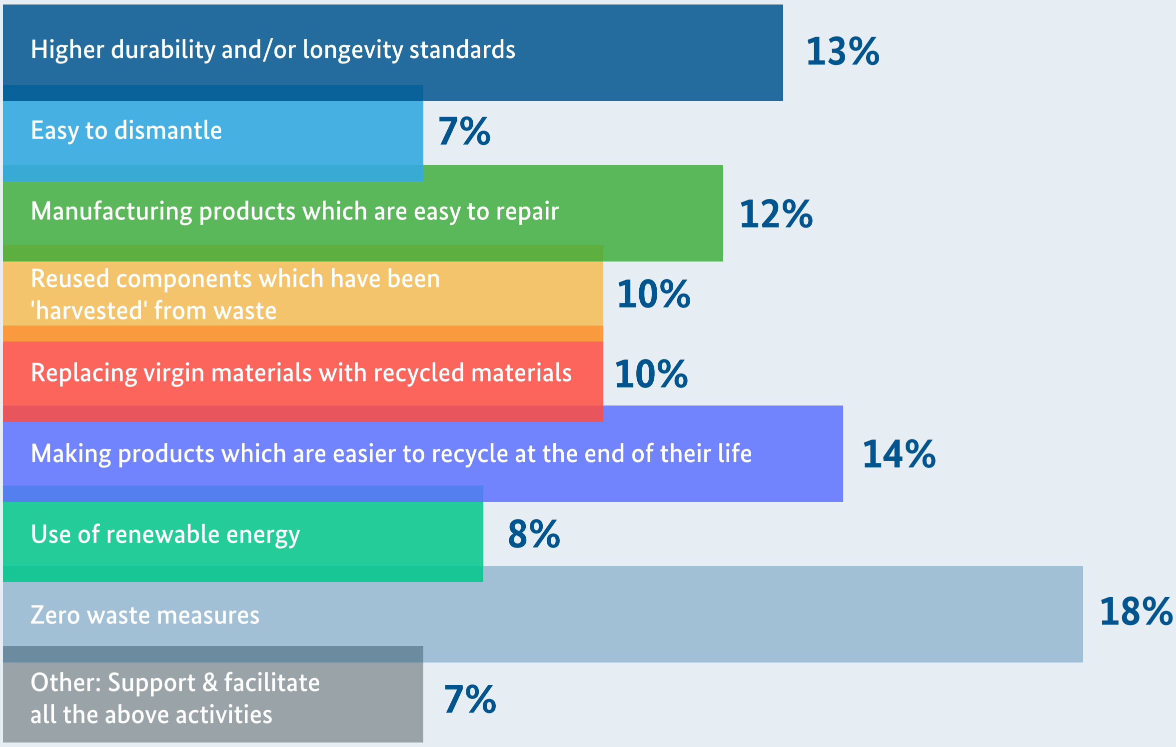

Figure 3-5 Sustainability and circular economy practices reported by survey respondents

Source: Own illustration

When considering the different ICT subsectors, some differences in practice can be detected (Figure 36). For example, zero waste measures appear to be more relevant in the electronic component and boards and the computers and peripheral equipment subsectors, while replacing virgin materials with recycled materials is the most reported practice within the consumer electronic sector (reported by 19% of companies compared to the overall 10% across all ICT subsectors). While the sample size is too small to draw statistically significant conclusions, the prioritisation of recycled plastic in consumer electronics does align with the identified priorities of brands identified in section 1.2.3. However, the fact only 6% of consumer electronics manufactures are making products which are easy to repair suggests that there is a gap in practice and what will soon be required of products imported into the EU and USA.

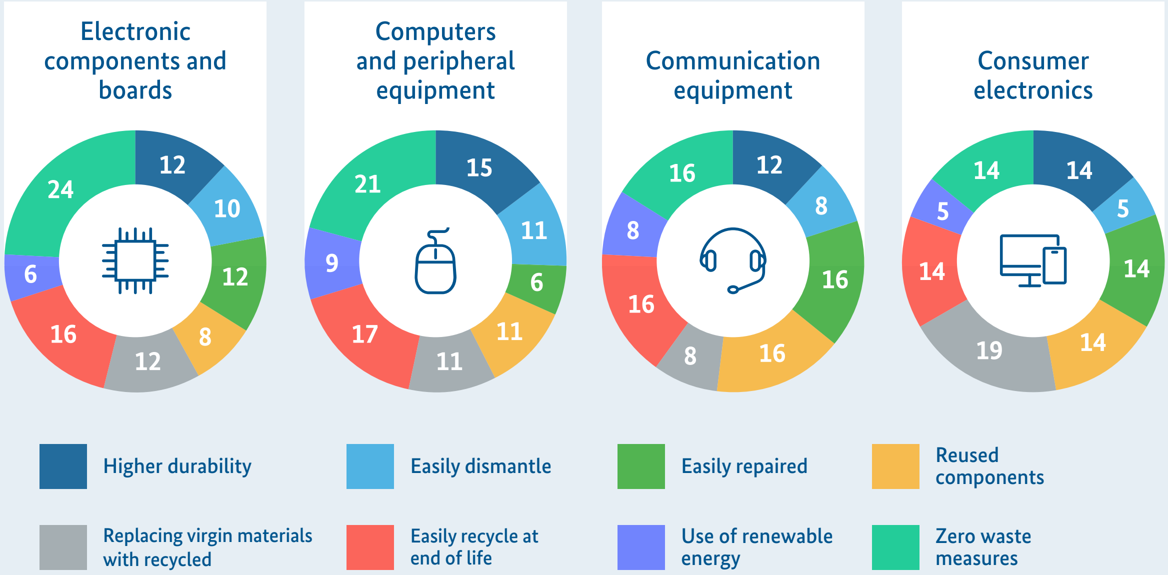

Figure 3-6 Sustainability and circular economy practices reported by survey respondents (by ICT subsector)

Source: Own illustration

3.3 Circular economy awareness among Malaysian ICT subsector companies

Respondents to the survey were asked how familiar they were with the concept of a circular economy (Figure 37). The majority (36%) responded that "I have heard the term circular economy before, but I am not sure what it means." Only 16% were "very familiar" with the concept, while a further 20% were "somewhat familiar". Over one-quarter of respondents (28%) have not come across the term before. During the interviews, only two respondents initially stated that they are very familiar with the circular economy concept, however, most reported some level of familiarity, with only two stating they had never heard the term at all, and all interviewees understood the concept after some explanation and were able to give examples of activities that their companies undertake that can relate to the concept of a circular economy.

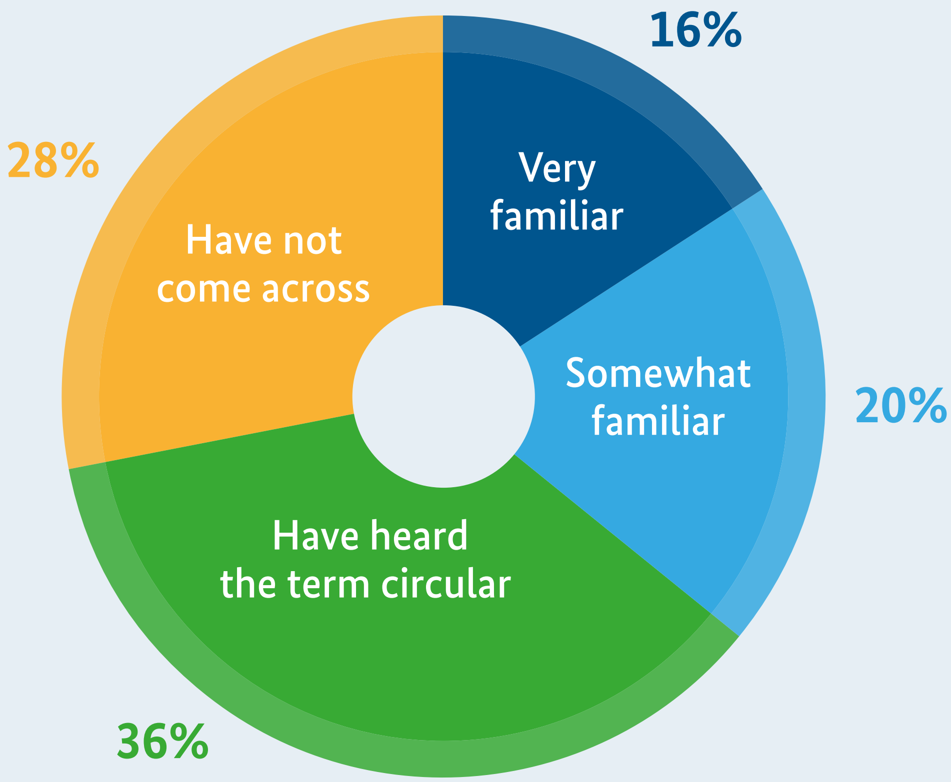

Figure 3-7 Familiarity with the concept of a circular economy

Source: Own illustration

When the different ICT subsectors are considered (Figure 310), overall awareness of the circular economy concept is higher in the computers and peripheral equipment and the consumer electronic subsectors, where 85% of respondents had some level of awareness, compared to three-quarters (75%) of the electronic components and boards subsector, and only half of the communication equipment subsector (50%). When comparing company size (Figure 39), larger companies are more likely to have some familiarity with the concept, with only 21% having not come across the concept before, compared with half of companies with less than 250 employees.

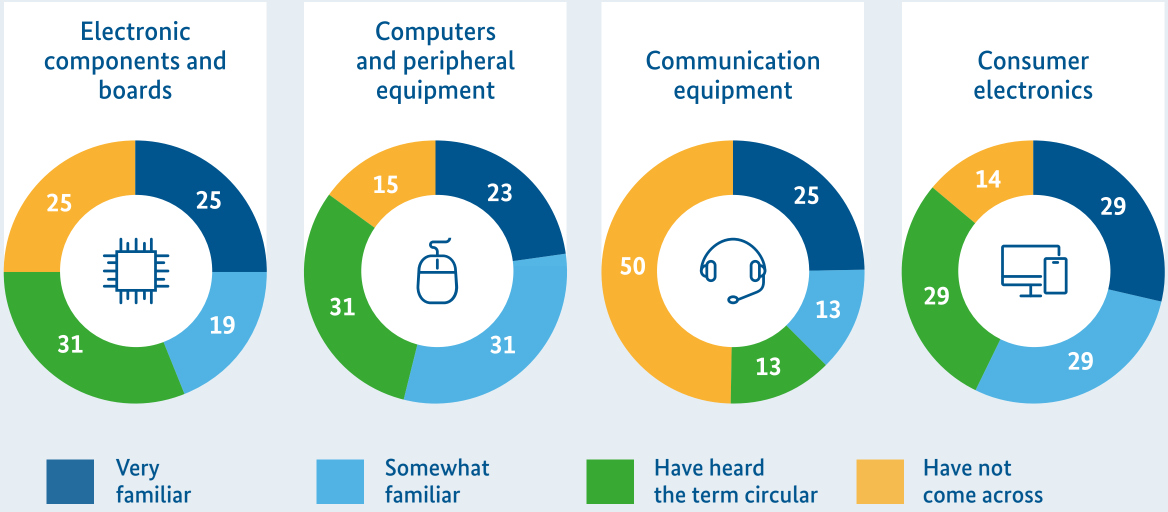

Figure 3-8 Familiarity of circular economy concept by subsector

Source: Own illustration

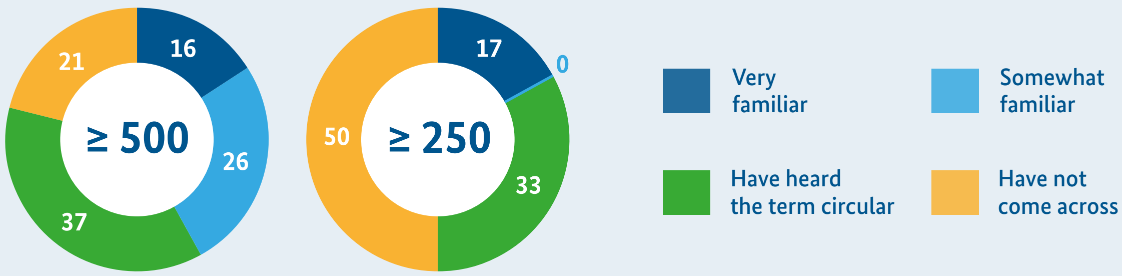

Figure 3-9 Familiarity with circular economy concept by number of employees

Source: Own illustration

For those already familiar or aware of the concept of a circular economy, 'customer requests' and 'policy initiatives in third countries' appeared to have equal weight, with both cited by 28% of respondents as the source of this awareness (7 responses each), as shown in Figure 310. Overall, 'Policy and/or communication from national or local government' was only reported by 5 respondents (20%). Policy initiatives of third countries appears to be more influential in the consumer electronics sector than customer requests. In terms of subsector (Figure 311), a difference between these sources could only be detected in the consumer electronics subsector, where the policy initiatives of third countries appear to be more influential than customer requests (43% compared to 29%).

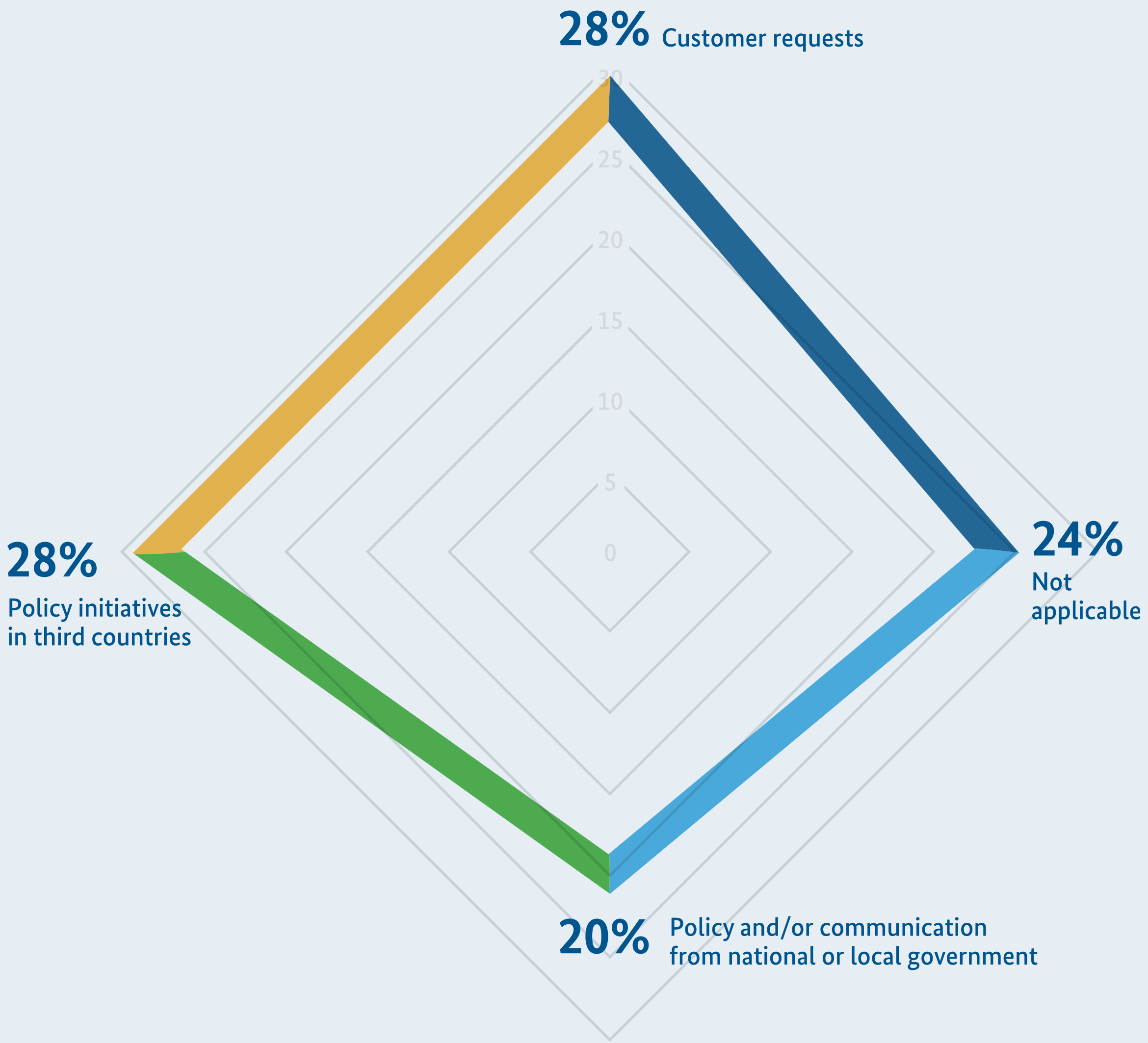

Figure 3-10 Source of familiarity with the circular economy concept

Source: Own illustration

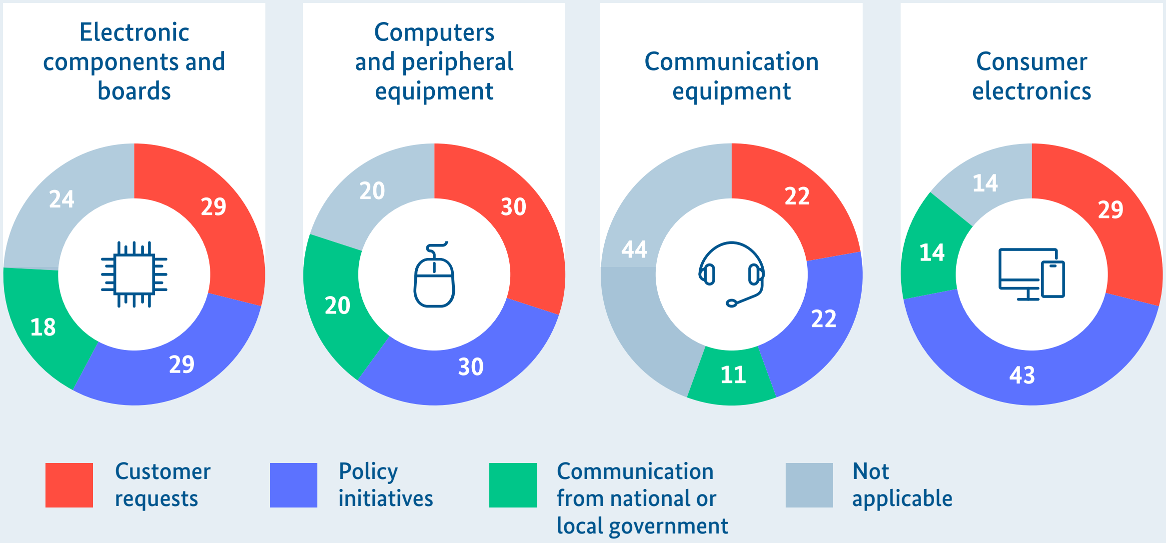

Figure 3-11 Source of circular economy awareness according to subsector

Source: Own illustration

3.4 Challenges for implementing circular economy measures in Malaysian ICT subsectors

Survey respondents were asked to indicate which challenges do or could prevent the implementation of circular economy design measures in their company. As shown in Figure 312, the two largest challenges are a lack of demand[12] for circular products (21%), and an inability to access finance for necessary investments and upgrades (20%). Difficulties accessing test labs which could certify specific standards and the expense of testing and certification were also cited as challenges by 17% of survey respondents. Some differences between subsectors also exist, as shown in Figure 313. For example, electronic components and board subsector viewed accessing labs (23%) as the most common challenge, while technical skills were rated as more important in the electronic components and boards and the computers and peripheral equipment subsectors than in other subsectors. For companies with less than 250 employees, access to finance was the greatest challenge, cited by one-third of respondents (Figure 314).

12 Lack of demand is refers to demand from key customers and end-consumers, however, it could also be interpreted as lack of regulatory requirements (i.e. regulatory demands). Both, however, are interlinked, as regulatory requirements will lead to key customers demanding circular products from their supply chain.

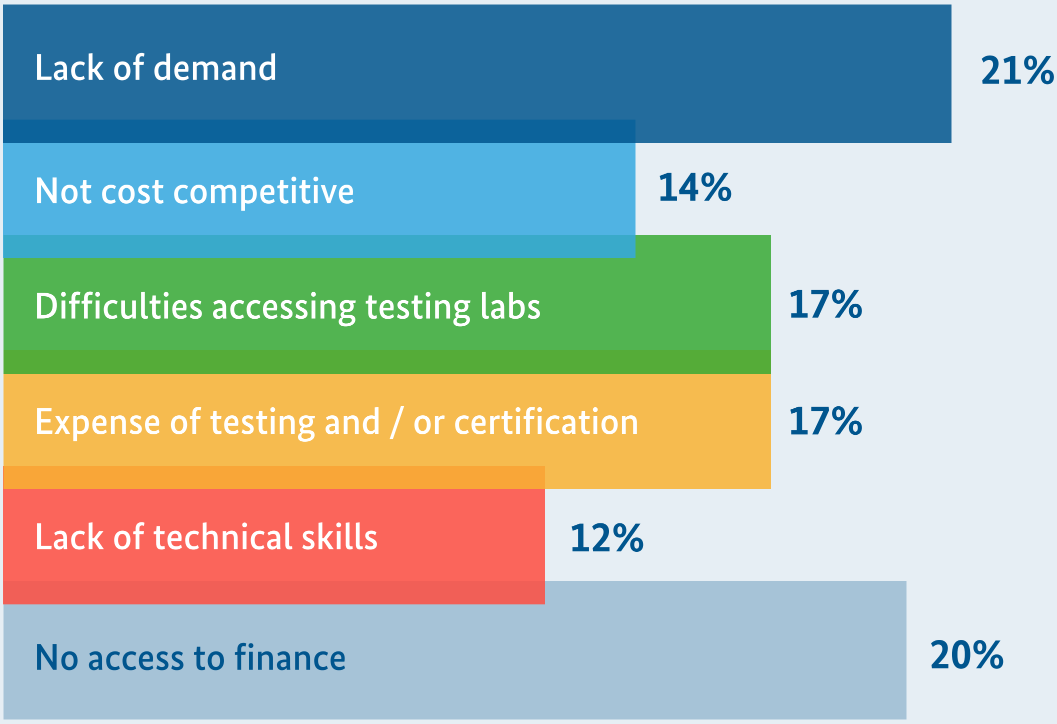

Figure 3-12 Main challenges to implementing circular economy design measures

Source: Own illustration

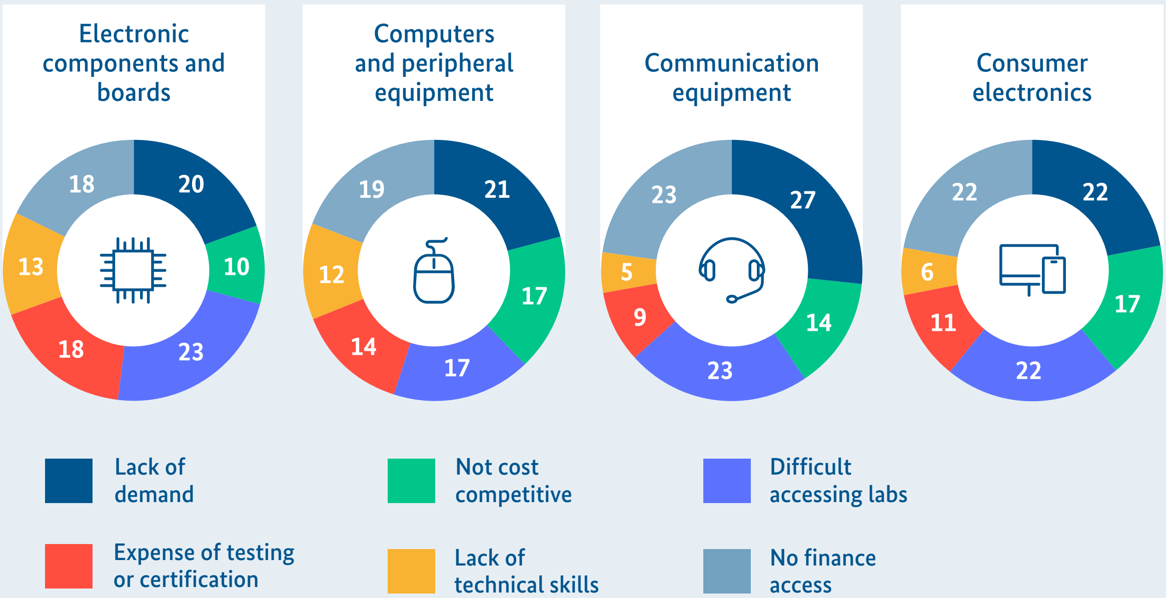

Figure 3-13 Main challenges to implementing circular economy design measures according to subsector

Source: Own illustration

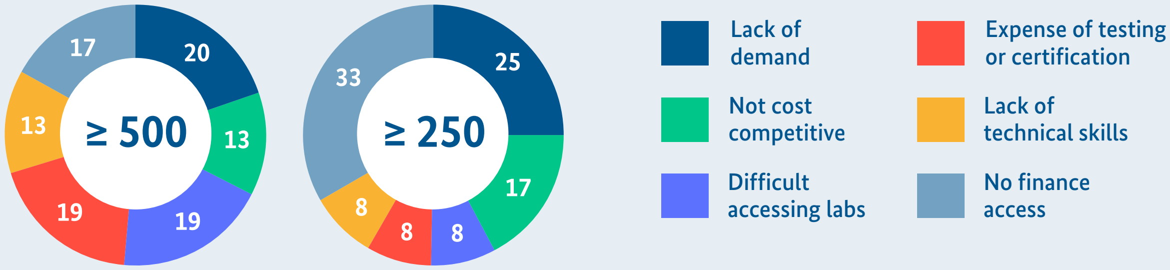

Figure 3-14 Main challenges to implementing circular economy design measures according to number of employees

Source: Own illustration

It should be stated, however, that the first challenge to implementing the circular economy is the lack of awareness of familiarity with the concept, as identified in 3.3. This point was reiterated in the interviews, where it was mentioned that the circular economy cannot be implemented until it is fully understood. Reasons for this lack of understanding was explored further, with some respondents stating that as far as they were aware, there are no incentives from the government to practice circular economy. For this reason, higher management also does not give priority to this matter. One interviewee elaborated that while there are various policies and roadmaps in place, the enforcement and implementation on the ground is low.

It was also mentioned by several that the primary concern of management is profitability, although one interviewee was aware of the opportunities to reduce their operational costs through circular economy measures.

The challenge of securing the necessary investment for adopting circular economy practices was also mentioned. One interviewee also mentioned the importance of stability for generating a good investment climate.

Finally, three interviewees mentioned that more should be done to improve e-waste recycling in Malaysia, stating that the e-waste recycling rate in Malaysia is low, and there is no mandatory legal framework which requires consumers to send EEE waste to licensed e-waste recovery.

Survey respondents and interviewees were asked what policies or initiatives could help them overcome the challenges to implementing a circular economy. The top five responses from the survey (as shown in Figure 315) were that government should: (a) provide financial support (18%), (b) raise awareness on circular economy (17%), (c) increase demand for circular ICT product through public procurement (16%), (d) enact legislation related to circular economy (13%), and (e) develop roadmap for circular economy (12%).

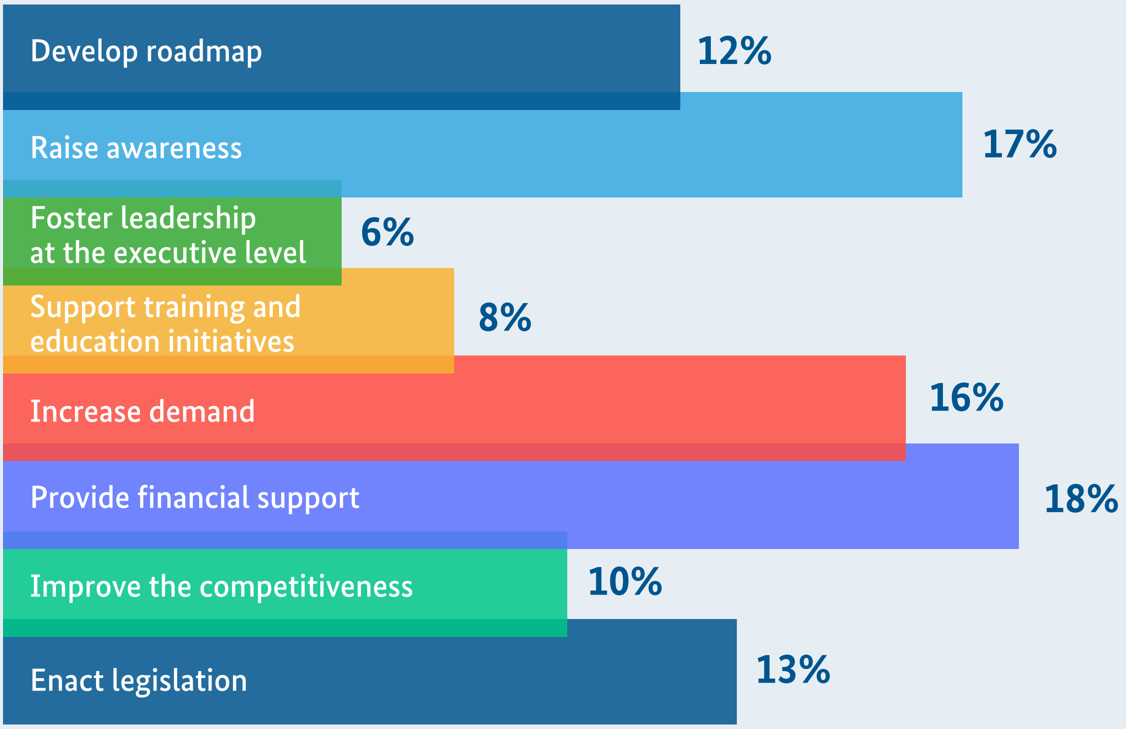

Figure 3-15 Policies or initiatives that can support greater uptake of circular economy design measures among the Malaysian ICT sector

Source: Own illustration

The relative importance of these measures differed between the ICT subsectors. For example, as shown in Figure 315, financial support was the main concern in all subsectors except for the consumer electronic subsector, where developing a roadmap was the number one measure (24% compared to 16%).

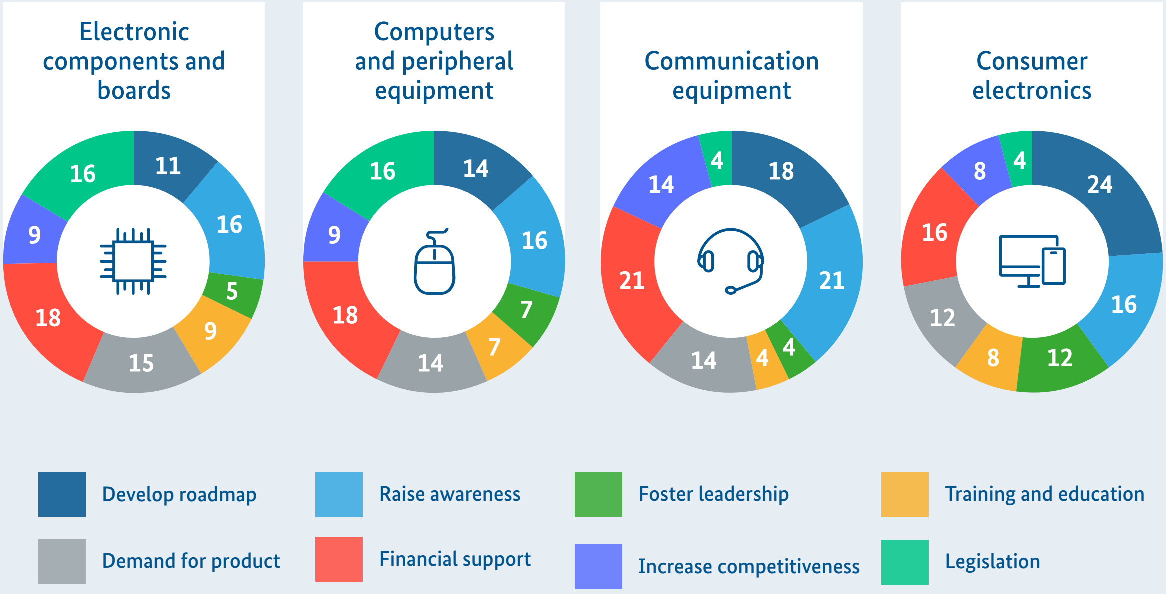

Figure 3-16 Policies or initiatives that can support greater uptake of circular economy design measures according to ICT sub-sector

Source: Own illustration

Despite the challenges, many Malaysian-based ICT companies consider that the circular economy presents new opportunities. The answers of the interviewees can be grouped into two main themes. For some respondents, circular economy approaches present opportunities to meet the increasing demand for more environmentally friendly goods. As consumers' awareness of environmental issues increases, they are becoming more sensitive to the sustainability of the products they buy. In particular, companies with R&D departments see the potential to increase their sales, while manufacturing services providers (i.e. manufacturers offering tailor-made manufacturing solutions) see that circular economy can create new opportunities, especially in international markets impacted by circular economy policies. In addition to meeting new demand, other interviewees raised the potential for circular economy measures to reduce operational costs. For example, one interviewee (Intel) highlighted that its circularity efforts in 2021 delivered over $100 million in revenue, more than $1 billion in cost avoidance and enabled the company to avoid, recycle, reuse, or recover more than 130,000 metric tons of manufacturing waste (Intel 2022).

During the interviews, the impact of current policy initiatives on circular economy practices was also discussed. However, the majority of the respondents felt that these are more focused on green technology and waste management in general, and that other supporting factors such as creating demand for circular products and greater financial support should be instigated as part of the government's circular economy agenda. For example, two interviewees suggested that a tax reduction of around 2% would free up resources for the creation of circular economy focussed activities and jobs. Malaysian-based interviewees also suggested financial institutions should be encouraged by the government to offer a better interest rate to companies that want to invest in circular economy operations.

4 Recommendations

In order to transition to a circular economy, a spectrum of reinforcing policies are needed to increase demand for and supply of circular products while closing resource loops. These should: target the market by creating demand for circular products through minimum standards as well as incentives to improve performance; enhance waste management by improving the capture of valuable resources from both national and global waste streams; and, incentivise and invest in circular capacities within the Malaysian ICT manufacturing sector through awareness raising, capacity building, as well as financial incentives.

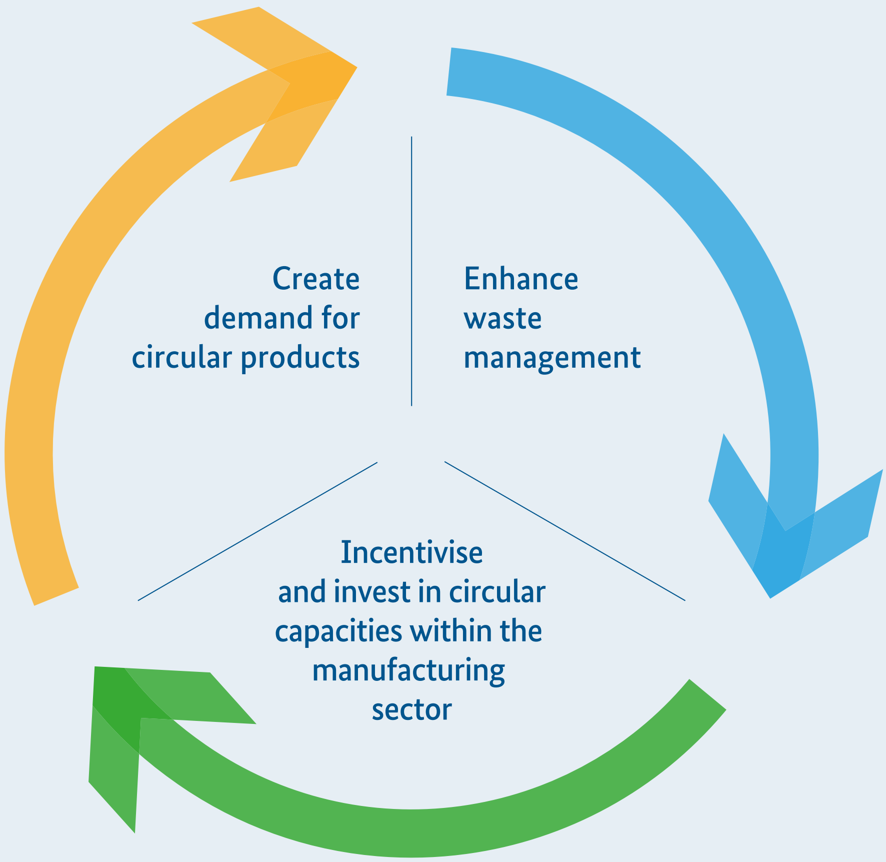

Figure 4-1 Policies for a circular economy transition in Malaysia

Source: Own illustration

The goal of a coordinated policy framework is to create positive reinforcement between policy areas, which is an essential element of system change. For example, if the number of circular products on the market increases, it will become easier for waste management processes to separate and reclaim valuable components and materials, which in turn will increase the predictability and price parity of closed-loop material flows back into the manufacturing sector.

4.1 Create demand for circular products

4.1.1 Set mandatory minimum ecodesign standards for ICT products sold on the Malaysian market

Minimum mandatory environmental requirements should be set for electrical and electronic products being sold on the Malaysian market. By ensuring all ICT devices sold in Malaysia are suitable for durability, repair, remanufacturing and recycling, ecodesign standards can be used in combination with effective e-waste collection to support the ICT sector access the used components or recycled materials it requires for circular manufacturing.

Product conformity assessment and market surveillance structures are already in place in Malaysia, however, there are currently no mandatory environmental criteria to stop products entering the Malaysian market. In order to introduce new minimum mandatory environmental criteria for ICT as well as other priority products, Malaysia requires an overarching ecodesign regulation. This should set the legal conditions to effectively ban environmentally non-compliant products from entering the Malaysian market.

Following this, minimum ecodesign requirements should be established for priority product categories including ICT. To do so, market and product characteristics, as well as environmental improvement options must be compiled in 'preparatory studies' laying the basis for stakeholder consultation and decision-making on eco-design measures. Structure and methodology for such studies as well as for deriving eco-design criteria should be harmonized and can yield from experiences made in the EU eco-design policy process.

A national-level body should be given a clear mandate by the Malaysian Government to drive the implementation of ecodesign. This includes taking responsibility for implementation and coordinating the relevant input of other entities such as standard setting and conformity assessment bodies. Communication, education, promotion and awareness programmes will also be an essential element in driving industry and consumer receptiveness towards ecodesign.

4.1.2 Create demand for circular ICT products using public procurement

Public procurement has significant market leverage. As well as sending a signal to markets, buying more durable, repairable products can also result in financial benefits for public authorities. 100% GPP – or government green procurement (GGP) as it is called in Malaysia - of computer and laptops is already mandatory for national government ministries in Malaysia, and this is being rolled out to subnational and regional authorities. Currently, however, the ambition level of the GGP requirements remains low.

In combination with mandatory GGP requirements already established in Malaysia, there is a great potential to impact market practices by introducing circular design requirements into the mandatory minimum requirements of GGP. As a starting point, the definition of what can be counted as a 'green' procurement should be revised, so that only products representing an improvement over what is already commonly available on the market can be classed as 'green'.

4.1.3 Help consumers choose circular products using voluntary ecolabels

Malaysia has already established the government-endorsed MyHIJAU ecolabel recognition scheme, which aims to bring together all the environmentally certified product and services meeting local and international environmental standards under one single label (MyHIJAU n.d.). This simplifies the complex landscape of labels available on the market, making it easier for consumers to make environmentally responsible choices. However, as of January 2023, no ecolabelled ICT products are listed in the MyHIJAU Directory, despite the fact that a number of ICT brands/OEMs offer ICT devices meeting global ecolabel standards.

It is therefore recommended that the Malaysian Green Technology and Climate Change Corporation (MGTC) are supported to increase the availability of ecolabelled ICT products on the Malaysian market, for example, through dialogue with brands/OEMs, certification bodies and other stakeholders (such as major buyers and retailers). This should be combined with targeted communication to consumers to highlight the availability and benefits of environmentally friendly ICT products (such as the cost saving potential of more durable and/or repairable devices).

4.2 Enhance waste management

4.2.1 Extended Producer Responsibility for E-Waste

EPR is an internationally recognized concept that requires companies that produce and sell defined products to take over the responsibility for environmentally sound management of the wastes arising from these products. The Malaysian Government has already committed to introducing EPR for household electrical and electronic waste in its Twelfth Five-Year Plan (Malaysian Government 2021). It is important that the introduced EPR system has clear objectives, measurable targets and clearly assigned responsibilities, which are cast into binding legal requirements. The alternative – a voluntary EPR system – would not ensure broad enough industry participation and long-term stability. Targets could include setting a mandatory collection and recycling rates (for example, at least 50% of the volume of electronic products placed on the market). Targets may be phased, with increasing ambition over time.

4.2.2 Improve e-waste collection and recycling infrastructure

The implementation of an EPR scheme can create new opportunities for financing the improvement of e-waste collection and recycling. A particular gap which must be addressed is the controlled and segregated collection of end-of-life EEE from end consumers in Malaysia. By capturing and recycling more domestic e-waste, the security of supply of recycled materials will be improved for supply-chain actors.

It is also important that recycling is conducted in a way which meets high standards of pollution-control, and which minimises open-loop recycling (i.e. done in a way which enables reuse and high-quality material recovery as opposed to the cascading of material to lower-value uses). This requires assurance systems. Brands/OEMs need these assurances to ensure that materials used in their supply chain are sourced from responsible, controlled sources, meaning traceability based on independent third party to a recycled content standard that conforms to ISO 14021 is important. The materials used in products must meet specific quality specifications, including strength, durability, and safety. Developing technical expertise in relevant test methods and facilitating access to these test methods is also therefore important.

Finally, governments should look to support research and development of innovative approaches in sorting and metallurgy which can help to increase material recovery from complex waste compositions at high values. Financing should be available to launch and scale-up innovation where suitable activities are identified.

4.3 Incentivise and invest in circular capacities within the manufacturing sector

4.3.1 Increase awareness of circular economy opportunities among manufacturers

Collaboration between brands/OEMs and supply-chain actors is essential for developing more circular solutions. In a linear economy, brands set specifications, which manufacturers then deliver. A circular economy is, however, more complex. Brands/OEMs are being required to develop new specifications, many of which are being driven by regulation. This means that brands/OEMs will not need suppliers who can simply react to orders, but who can also proactively participate in the search for viable, innovative solutions.

Currently, circular economy practices within the Malaysian ICT sector are low, as is circular economy awareness. Communication, education, promotion and awareness raising are essential for supporting the Malaysian supply-chain to adapt to emerging market realities. To do so, appropriate communication channels must be used or developed, and communication messages should focus on market direction and the benefits of circular products for society, the economy and the environment. Messages should be targeted towards the specific ICT subsectors (i.e. zero waste measures for electronic components and boards manufacturers, compared to circular design for computer and peripheral equipment manufacturers). Special efforts are also required to target Small and Medium-sized Enterprises (SMEs).

4.3.2 Increase investment in the circular economy transition

In addition to low-awareness, access to finance has been identified as one of the key challenges to adopting circular economy practices in the Malaysian ICT supply chain. Priority sub-sectors may therefore benefit from temporary incentives such as tax incentives, grants and soft-loans (i.e. loans paid back with low or no interest).

One opportunity includes expanding the scope of the GITA tax allowance scheme for green investments to include investments in equipment or solutions which enable circular economy manufacturing (for example, remanufacturing operations). GITE could also be expanded to include feasibility and advisory services on circular manufacturing. In addition, the existing opportunities to claim tax exemptions under GITE on green certification and verification services in relation to circular design should be the subject of targeted communication to ICT subsectors.

Another opportunity which exists is the Pioneer Status or Investment Tax Allowance under the Promotion of Investments Act 1986. Companies who are undertaking high-value added local waste recycling activities using green technologies are eligible for this support. When combined with improved consumer e-waste collection systems, new opportunities to increase the recycling of domestically generated e-waste for feedstock to Malaysian companies can be realised.

4.3.3 Capacity building of key actors

Certification and market surveillance infrastructure is already in place in Malaysia. However, as covered in 4.1.1, there are currently no minimum ecodesign standards to guide industry processes and product development. These standards will have to be developed, and the capacities of certification and market surveillance bodies must be built accordingly. The Malaysian Government should develop a roadmap which sets out the requirements and challenges for defining circular economy standards for key product areas, including ICT. This should be developed in collaboration with industry, academia, the public sector and civil society.

4.4 Recommendations for international development actors

International development actors are active participants in the Malaysian economic development and environmental protection sphere and can provide strategic support via finance and technical expertise to Malaysia's circular economy transition. As such, recommendations for international actors working to support the Malaysian Government have also been developed. In addition to working in tandem with the priorities of the Malaysian Government, international actors should also coordinate their activities with one another, thereby reducing duplication and increasing synergies between initiatives and doner programmes.

4.4.1 Embedding circular economy into relevant policy agendas

International development actors should work with national governments to help set policy agendas. With regards to the circular economy, particular action is required to expand the focus of measures beyond waste management to also include higher rungs of the waste hierarchy (i.e. measures promoting lower consumption, longer lifetimes, and more reuse and repair). This can be achieved by embedding circular economy measures in policy portfolios beyond waste management, including identifying links between the circular economy and Nationally Determined Contributions (NDCs) to global GHG emission reductions, biodiversity goals, and other sector-specific roadmaps. Crucially, circular economy should not be restricted to environmental policies, but should also be embedded in economic strategy, for example, via development strategies or sector-specific industrial policies. The GSI's T20/G20 network represents a particularly important forum for embedding circular economy into the sustainable economic policy agenda.

It is also essential that circular economy is embedded throughout international development actors project portfolios. It should not be the case that circular economy is promoted through one project, while development models based on business-as-usual trajectories are promoted in others. This lack of coherence leads to mixed messaging and competing policy agendas.

4.4.2 Technical Cooperation

International development actors should provide technical support on topics such as developing product standards, including minimum ecodesign requirements, voluntary ecolabel specifications and guidelines on GPP. A 'standardisation roadmap' for the circular economy, such as that being developed for key sectors in Germany (DIN e.V. n.d.), could provide a valuable basis for identifying requirements, challenges and actions for developing suitable standards for supporting the circular economy.

Technical coopetration should also include the development of EPR systems, improved support for and surveillance of the e-waste recycling sector, and the development and implementation of financial incentives (such as innovation grants and soft-loans). This technical support should be accompanied by relevant capacity building of institutions and officials within partner countries, such as standardisation and regulatory bodies, as well as other value chain actors such as SMEs, in order to ensure that sustainable practices are embedded and taken up more widely.

4.4.3 Financial Cooperation

International development actors should support with the development of innovative financing schemes for the circular economy transition. This can include short-term direct support, such as loans, credits and other mechanisms which reduce market barriers to circular economy transition. Financial support should be aligned with the strategic policy agenda and should directly contribute towards clearly defined circular economy indicators. Financial support should also be supported with technical cooperation, for example focused on creating effective governance mechanisms and capacity development in managing funds and monitoring and evaluating the impacts of funding (i.e. the extent to which they have contributed to policy goals).

5 Conclusion

Transition to a circular economy is essential for meeting the current resource and climate challenges that our societies are faced with. Policies are already being implemented in markets such as the EU and China which seek to start processes of industrial transformation. For products with global value chains, such as the ICT sector, these policies will also impact the demands being placed on manufacturing sectors in other countries, such as in Malaysia, where the ICT sector represents an important pillar of the country's economy.

In order to meet these demands, countries like Malaysia should actively support the circular transition. Malaysia has already begun this process, recognising the importance of the circular economy in its Twelfth Five Year Plan. However, awareness and implementation of circular practices within industry remains low.

To address this, a framework of targeted, reinforcing policies are recommended in order to increase demand for and supply of circular products while closing resource loops. These should create demand for circular products by establishing minimum standards while also incentivising circular public and private consumption; enhance waste management by improving the capture of valuable resources; and incentivise and invest in circular capacities within the Malaysian ICT manufacturing sector through awareness raising, capacity building, as well as financial incentives.

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