

Chapter 10

Regional E-waste Status and Trends





Africa

UNU estimates that in 2016, domestic e-waste generation in Africa was approximately 2.2 Mt, with contributions from Egypt (0.5 Mt), South Africa and Algeria (each 0.3 Mt) ranking highest. The top three African countries that have the highest e-waste generation per inhabitant are: Seychelles (11.5 kg/inh), Libya (11 kg/inh), and Mauritius (8.6 kg/inh). Currently, little information is available on the amount of e-waste documented that is collected

and recycled by the formal sector in Africa. Only a handful of countries in the continent have enacted e-waste-specific policies and legislation. Recycling activities are dominated by ill-equipped informal sectors, with related inefficient resource recovery and environmental pollution. Most African countries are currently developing various models of EPR schemes as part of their solution to the e-waste problem.

The African continent hosts the least number of direct manufacturers of EEEs, yet it carries a significant burden of contribution to the global e-waste problem, generating about 2.2 Mt annually from domestic output. Most of this is derived from imports of new and used equipment, and a few local assembly plants. Locally derived generation is believed to constitute about 50% to 85% of total e-waste generation, the rest being from the transboundary illegal import from developed countries in the Americas and Europe, and from China (Secretariat of the Basel Convention, 2011). Annual domestic generation in Egypt (0.5 Mt), South Africa and Algeria (each 0.3 Mt) rank highest in the region. However, some of the continent's smaller but richer countries (Seychelles, Mauritius) generate 11.5 kg/inh and 8.6 kg/inh respectively, in comparison to the African average of 1.9 kg/inh and world average of 6.1 kg/inh. Local generation of e-waste is expected to rise in the future with the penchant for consumption of foreign goods and the quest for comfort associated with consumer goods.

Most African countries are now aware of and concerned with the dangers inherent to poor management of e-waste. However, the legal and infrastructural framework for achieving sound management still remains far from realised in the majority of countries. Only very few countries (including Uganda and Rwanda) have any formal official government policy documents specific to e-waste management. In addition, despite the fact that almost all African countries have ratified the Basel Convention, most have not domesticated this in the form of appropriate legislations for various waste streams. As yet, only Madagascar (2015), Kenya (2016), and Ghana (2016) have formally passed a draft of e-waste bills into law. Several other countries (South Africa, Zambia, Cameroon, and Nigeria) are still working to achieve this in parliament. In Nigeria, the draft is already

officially being enforced for e-waste control by the country's environment regulatory agency. E-waste imports are prohibited by this regulation, and its enforcement has resulted in the repatriation of several illegal e-waste shipments that arrived in Nigeria stuffed in second-hand vehicles or other containers; for more information, see the chapter on transboundary movement in this report¹¹. The Kenya E-waste Act, which still awaits official approval before public dissemination, has as one of its highlights that no company will manufacture or import any EEE without indicating where its e-waste will be treated at end-of-life. The Ghana legislation prohibits imports and exports of e-waste, phases out the inclusion of printed circuit boards in electronic equipment, provides for the registration of manufacturers, importers, and distributors, as well as the establishment of an e-waste management fund to be achieved through payment of an advance eco-fund by manufacturers, importers, and distributors. Draft bills and regulations of many other African countries incorporate several of these features.

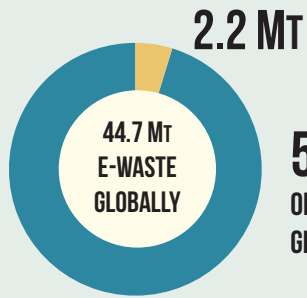
Based on these previous mentioned initiatives, governments in many African countries have begun showing increasing concerns and interest in adopting comprehensive and integrated approaches to solving the e-waste problem. Such approaches will integrate the informal sector into the official management structures, establish take-back schemes, Extended Producer Responsibility (EPR), and Producer Responsibility Organisations (PROs) schemes. In this regard, many countries are currently receiving advisory, technical, and financial support from several UN agencies, other development agencies, the private sector, and especially from the alliance of Original Equipment Manufacturers (OEMs) in Africa.

The government of Egypt partnered with the Sustainable Recycling Industries (SRI) in a

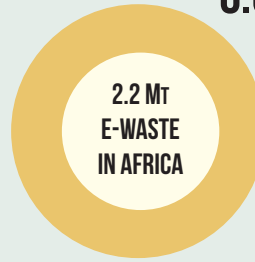
53 COUNTRIES
IN AFRICA

1.2 BILLION
INHABITANTS

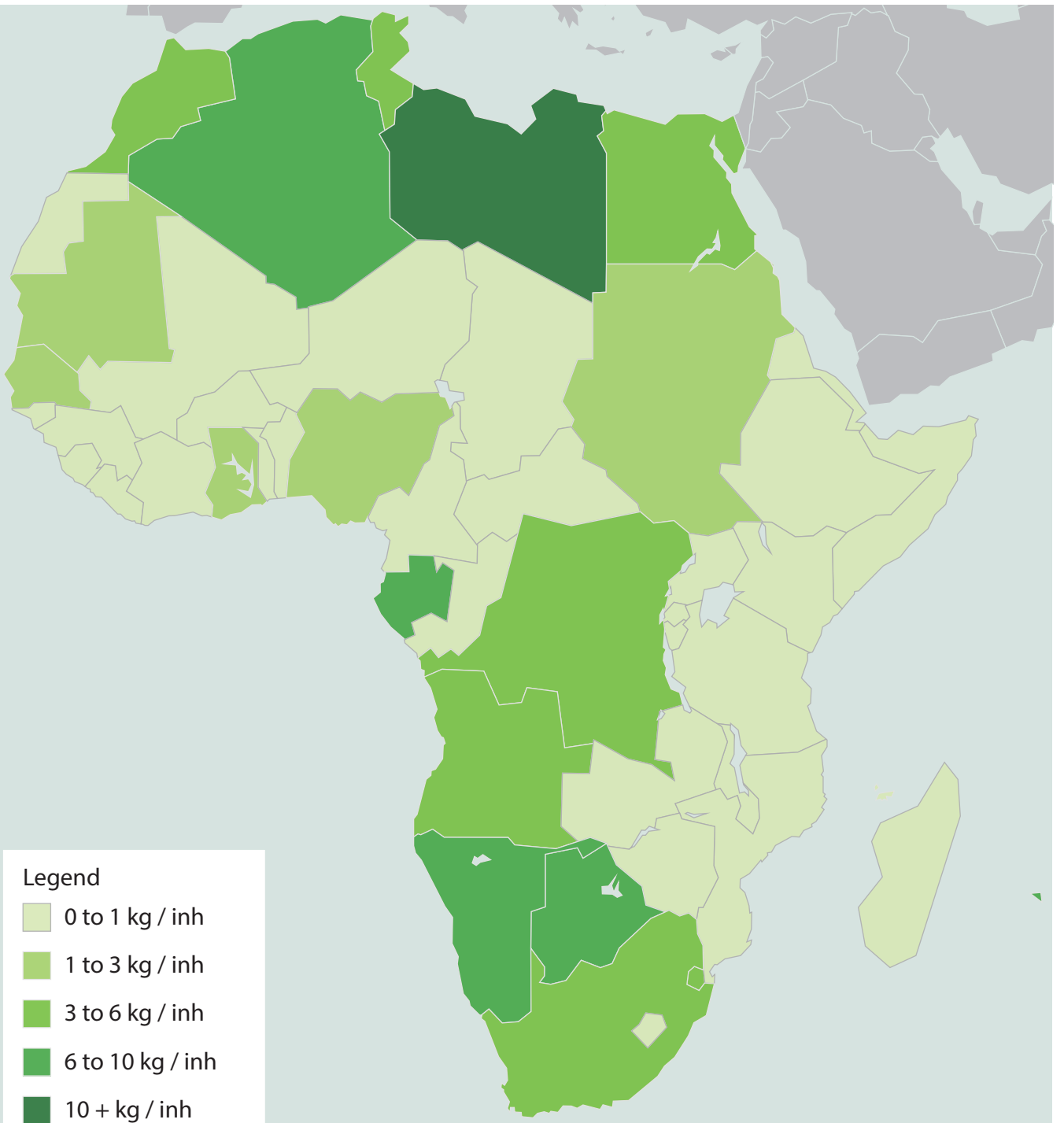
1.9 KG OF E-WASTE
PER INHABITANT



5%
OF WORLD E-WASTE
GENERATION IN AFRICA



0%
COLLECTION
RATE IN AFRICA



programme whereby an agreement was signed to build the capacity and raise awareness towards efficient, environmentally sound, and sustainable e-waste recycling. It focuses on the recycling of electronic and electric waste as a promising emerging industry. The Government of Italy has provided \$4 million to implement the Third Phase of the Egyptian-Italian Environmental Cooperation Programme (EIECP), which is implemented under the supervision of UNDP. This package includes a safe health and electronic waste management programme in order to reduce emissions of harmful solid organic pollutants.

In Nigeria and Kenya, the proposed EPR schemes require manufacturers and importers to formulate their EPR procedures and obtain approvals from the government, whereas the Ghana model is based on the payment of eco-fees from such manufacturers and importers to a fund to be managed by government and the industry, and used for managing e-waste. The draft e-waste-specific EPR scheme for South Africa also features elements that are similar to the Nigerian, Kenyan, and Ghana proposals/model. The EPR scheme has good prospects in Africa but may be problematic due to several factors, including the mistrust of the scheme by an apprehensive informal sector, the lack of recycling infrastructure and standards, socio-cultural difficulties with take-back schemes, choice of appropriate EPR models, difficulty with defining who is a 'producer' in the context of a lack of real manufacturers, and generally poor financial support for the scheme.

E-waste management in Africa is dominated by thriving informal sector collectors and recyclers in most countries, as take-back schemes and modern infrastructure for recycling are non-existent or grossly limited. Government control of this sector is at present very minimal and inefficient. Handling of

e-waste is thus characterised by manual stripping to remove electronic boards for resale, open burning of wires to recover few major components (copper, aluminium, iron), and the deposition of other bulk components, including CRTs, in open dumpsites. This practice by the informal sector often involves the use of illicit labour of pregnant women and minors, as well as a lack of personal protection equipment for the workers. Resulting from such practices is the severe pollution of the environment, very poor efficiencies in recovery of expensive, trace, and precious components, and the exposure of labourers and the general populace to hazardous chemical emissions and releases. The Agbogbloshie site in Ghana is the classic example that has received international attention and concern. In this context, the use of standardised modern e-waste recycling plants should have been a good solution. It is noteworthy, however, that a few modern recycling plants that were established in some east African countries (e.g. Kenya, Uganda, Tanzania) have suffered business failures and closures due, in part, to adoption of inappropriate business models. Notwithstanding such failures, there is now renewed interest by private business outfits to establish recycling plants in many parts of the continent.

E-waste management problems and attendant remedies are somewhat similar in the various sub-regions of Africa. In summary, the major problems include the lack of adequate public awareness, lack of government policy and legislation, lack of an effective take-back/collection system and EPR system, the dominance of the recycling sector by an uncontrolled, ill-equipped informal sector that pollutes the environment, lack of adequate recycling facilities, and poor financing of hazardous waste management activities.

Americas

In the Americas in 2016, the total e-waste generation was 11.3 Mt. Only 1.9 Mt is documented to be collected and recycled, mostly coming from North America. The geographical distribution and e-waste management characteristics are very different across the continent. The richer areas (USA and Canada) produce the most e-waste per inhabitant: around 20 kg/inh. USA and Canada have, respectively, state and provincial laws to

manage e-waste, and the most data available. The rest of the continent is relatively well-developed, compared to the rest of the world, and generated on average 7 kg per inhabitant. For South America, there are fewer laws in effect to manage e-waste, and most of the e-waste is managed by the informal sector and private companies.

The top producer of e-waste in the Americas is the United States of America, with 6.3 Mt. The second largest producer of e-waste is Brazil, with 1.5 Mt, and the third is Mexico, with 1 Mt. UNU estimation studies show that the USA collected approximately 1.4 Mt of e-waste, which is 22% of the e-waste generated. The whereabouts of the remainder of the e-waste is largely unknown in the USA.

The EPA statistics show that only video products, audio products, telephones, mobile phones, fax, desktops, laptops, screens, printers, and other peripherals are included, instead of all 54 UNU-KEYS (Annex 1). Thus, the low collection rate is partially an issue of scope in the governmental statistics. Considering only the products in the EPA's scope, the collection rate for the USA rose to 70%. It is also likely that some of the e-waste is exported to other countries, since the USA did not ratify the Basel Convention that restricts the transboundary movement of international hazardous waste. In 2010, it was estimated that 8.5% of the collected units of computers, TV's, monitors, and mobile phones were exported as whole units (Duan et al, 2013). This weighed 26.5 kilotons (kt). Most larger electronic items, especially TVs and monitors, were exported over land or by sea to destinations such as Mexico, Venezuela, Paraguay, and China, while used computers, especially laptops, were more likely sent to Asian countries. The main destinations for mobile phones were Hong Kong (China), Latin American counties, and the Caribbean.

The USA still doesn't have national legislation in effect about the management of e-waste, and instead has regulations by state. 84% of the population in the USA is covered by legislation on e-waste. However, 15 states still don't have legislation in effect, including Alabama, Ohio, and Massachusetts. 25 states, plus Puerto Rico and DC, have some sort of consumer take-back law; 17 states and New York City have landfill bans (mostly

CRTs).

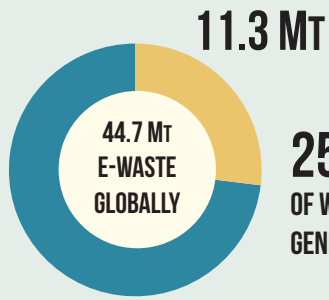
However, the USA undertook general measures to prevent e-waste and limit the adverse effects posed by unappropriated disposal and treatment. Electronics that are proved to be hazardous must follow the Resource Conservation and Recovery Act (RCRA), and be managed accordingly. Broken and intact Cathode Ray Tubes (CRTs) have explicit regulations that set specific requirements for their management, import, and export. The USA follows the National Strategy for Electronics Stewardship framework when developing new actions on electronics. Federal agencies are mandated to purchase electronics that are Electronic Product Environmental Assessment Tool (EPEAT) registered. EPEAT products are more environmentally preferable and require Original Equipment Manufacturers (OEMs) to offer electronics take-back programs to customers. Federal agencies are directed to use electronics recyclers that are certified to either the Responsible Recycling (R2) or the e-Stewards standards. A policy regarding the certification of the recyclers is under development. To date, there are over 700 electronics recycling facilities that have been independently certified to one or both of the certification programs.

Many initiatives are undertaken by the USA Environmental Protection Agency. Within the EPA's Sustainable Materials Management (SMM) Electronics Challenge, EPA partners with electronics OEMs and retailers to collect used electronics from the American public. The partners commit to using certified electronics recyclers to manage the material collected. This EPA-managed challenge is a national effort under the EPA's SMM Program, which challenges the EPA and other federal agencies throughout the country to lead by example in reducing the federal government's environmental impact, including the area of electronics. In this regard, the Challenge promotes

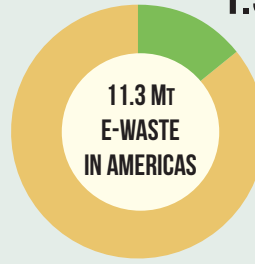
35 COUNTRIES
IN AMERICAS

1 BILLION
INHABITANTS

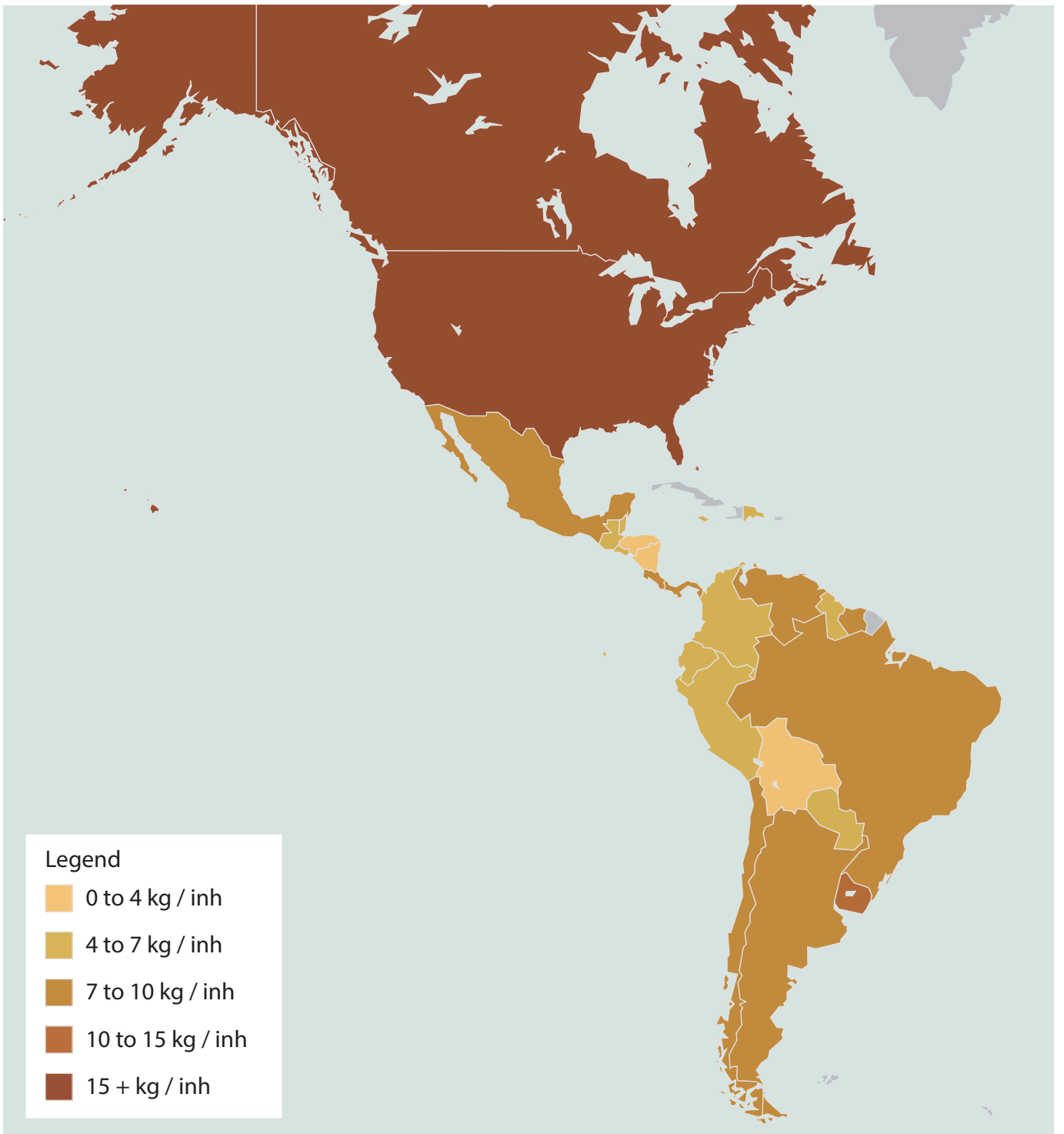
11.6 KG OF E-WASTE
PER INHABITANT



25.3%
OF WORLD E-WASTE
GENERATION IN AMERICAS



17%
COLLECTION
RATE IN AMERICAS



electronics stewardship in the federal government by encouraging federal facilities to purchase greener electronics (EPEAT registered), reduce the impacts of electronics during use (i.e. enabling power management and default to double-side printing), and to send used electronics to certified electronics recyclers so that used electronics can be managed in an environmentally responsible way. In particular, the program requires participants send 100% of collected electronics to certified recyclers, increase nationwide collection year over year, and increase collection in states without take-back laws. In 2015, the participants recycled about 256 kt of used electronics.

In addition to the USA, Canada still doesn't have national legislation in effect on the management of e-waste. However, most of the states have local regulation except the Yukon and Nunavut. Several organizations are working in various provinces to deal with the collection and recycling of e-waste. These organizations recycled approximately 20% of the total e-waste generated in 2016 (148 kilotons (kt)). The collection rate can be boosted by increasing awareness and by creating more centers to collect all kinds of e-waste throughout the country (Kumar & Holuszko, 2016).

In Latin America, 4.2 Mt of e-waste was estimated to be generated in 2016, with an average of 7.1 kg/ inh. The Latin American countries with the highest e-waste generation are: Brazil 1.5 Mt, Mexico 1 Mt, and Argentina 0.4 Mt. The top three countries in Latin America with the highest e-waste generation in relative quantities in 2016 were Uruguay (10.8 kg/ inh), Chile (8.7 kg/ inh), and Argentina (8.4 kg/ inh).

One of the main problems in this sub-region is the lack of e-waste regulation. Only 7 countries in Latin America enforce national legislation on e-waste (Bolivia, Chile, Colombia, Costa Rica, Ecuador, Mexico, and Peru). Some countries just recently started the process of promoting e-waste legislation (Argentina, Brazil, Panama, and Uruguay). Costa Rica initiated the process with an Electronic Waste Management Executive Decree in 2010. At the same time, Colombia adopted a national system for selective collection and management of computers and/or peripheral waste resolution. Recently, Colombia enacted national policy on the management of Electrical

and Electronic Waste Equipment (WEEE) (June 2017). Peru enacted an e-waste national regulation in 2012, while Ecuador adopted specific rules to regulate the take-back system for some e-waste categories. These countries all use the Extended Producer Responsibility principle as the common approach in their e-waste laws. In June 2016, Chile enacted the 20290 Bill "Framework Law on Waste Management, Extended Producer Responsibility, and Promotion of Recycling". So far, Argentina has developed legal frameworks only at the provincial level, mainly focused on the collection of e-waste. In this country, three bills projects have been presented in the congress. However, no national law has been approved.

There are only a few countries that have a defined regulatory framework and can count on formal recycling systems. However, these are often at an initial phase and improvements need to be done in the whole sub-region. Mexico collects most of the e-waste in Latin America (358 kt), which leads to a collection rate of approximately 36% compared to the e-waste generated. The collection rate in the rest of Latin America is lower than 3%. Argentina, for example, only 10.6 kt are collected and recycled compared to reported to be the 368 kt e-waste generated. In countries such as Argentina, the collection and recycling of e-waste is not regulated by a national law, therefore the e-waste is most likely treated by the informal sector or private recycling companies. The private recycling companies in Latin America mainly disassemble computers and cellular phones with the aim to recover the valuable materials contained in these items.

The main challenge with sustainable e-waste management in Latin America is the acceleration of all legislation processes. For the few countries that already have e-waste laws in effect, this is necessary to speed up their implementation. All the other countries in the sub-region have an urgent need to tackle this issue.

Improvements also need to be done in the research field. Only a few studies have been done so far to address the e-waste problem in Latin America, and all of them were conducted many years ago. The lack of a historical environmental culture in Latin America fuels the thought that the final user of EEE is not responsible for proper disposal and treatment.



Asia

In Asia, the total e-waste generation was 18.2 Mt in 2016. China generates the highest e-waste quantity both in Asia and in the world (7.2 Mt). Japan generated 2.1 Mt, and India 2 Mt. The top four Asian economies that have the highest e-waste generation in relative quantities are: Cyprus (19.1 kg/inh), Hong Kong, China (19 kg/inh), Brunei and Singapore (around 18 kg/inh). An average of 72%

of the population in Asia is covered by a national legislation on e-waste since the most populous countries in Asia (China and India) have e-waste rules. In East-Asia, the official collection rate is close to 25%, whereas in other sub-regions, such as Central and South Asia, it is still 0%, likely leaving most of the e-waste managed by the informal sector.

Compared to other continents, Asia is the most complicated, with many countries ranging from developing to industrial nations. This huge discrepancy has caused a highly complex e-waste management. United Arab Emirates, for example, is considered to have one of the world's lowest life expectancy of electronics and high amounts of consumption, making the country produce substantial amounts of electronic waste annually. The average resident in UAE generates 13.6 kg of e-waste, while Saudi Arabia and Kuwait produce the highest amount of e-waste per inhabitant in the Middle East (around 15.9 kg/inh). The continent also has countries that are still developing, such as Afghanistan and Nepal, and generate less than 1 kg/inh of e-waste.

The top e-waste producer in the world is China, which generates 7.2 Mt of e-waste according to our figures. According to another study, the amount of e-waste is expected to grow to 27 Mt by 2030 (Zeng et al. 2017). China plays a key role in the global EEE industry for several reasons; it is the most populous country in the world, so the demand of EEE is very high, and it has a strong EEE manufacturing industry. China has a big role also in the refurbishment, reuse, and recycling of e-waste. The formal e-waste recycling industry has shown considerable growth in treatment capacity and quality; 18% of the e-waste generated has been documented to be collected and recycled in recent years. China has national legislation in effect that regulates the e-waste collection and treatment of TVs, refrigerators, washing machines, air conditioners, and computers (desktop and laptops). However, due to a range of social and economic factors, the informal sector is still leading the business of collecting and recycling e-waste. This very often causes detrimental effects on the environment and health. Therefore, the growth of the formal sector is important in lessening the environmental and health impacts due to improper and unsafe treatment of e-waste.

Other countries have advanced e-waste regulation, such as Japan and South Korea. In Japan, most of the UNU categories are collected and recycled under the Act on Promotion of Recycling of Small Waste Electrical and Electronic Equipment. Japan was one of the first countries in the world to implement an EPR (Extended Producer Responsibility) based system for e-waste. Japan relies on strong legal framework, an advanced take-back system, and developed processing infrastructure. In 2016, Japan collected 546.4 kilotons (kt) through official channels¹².

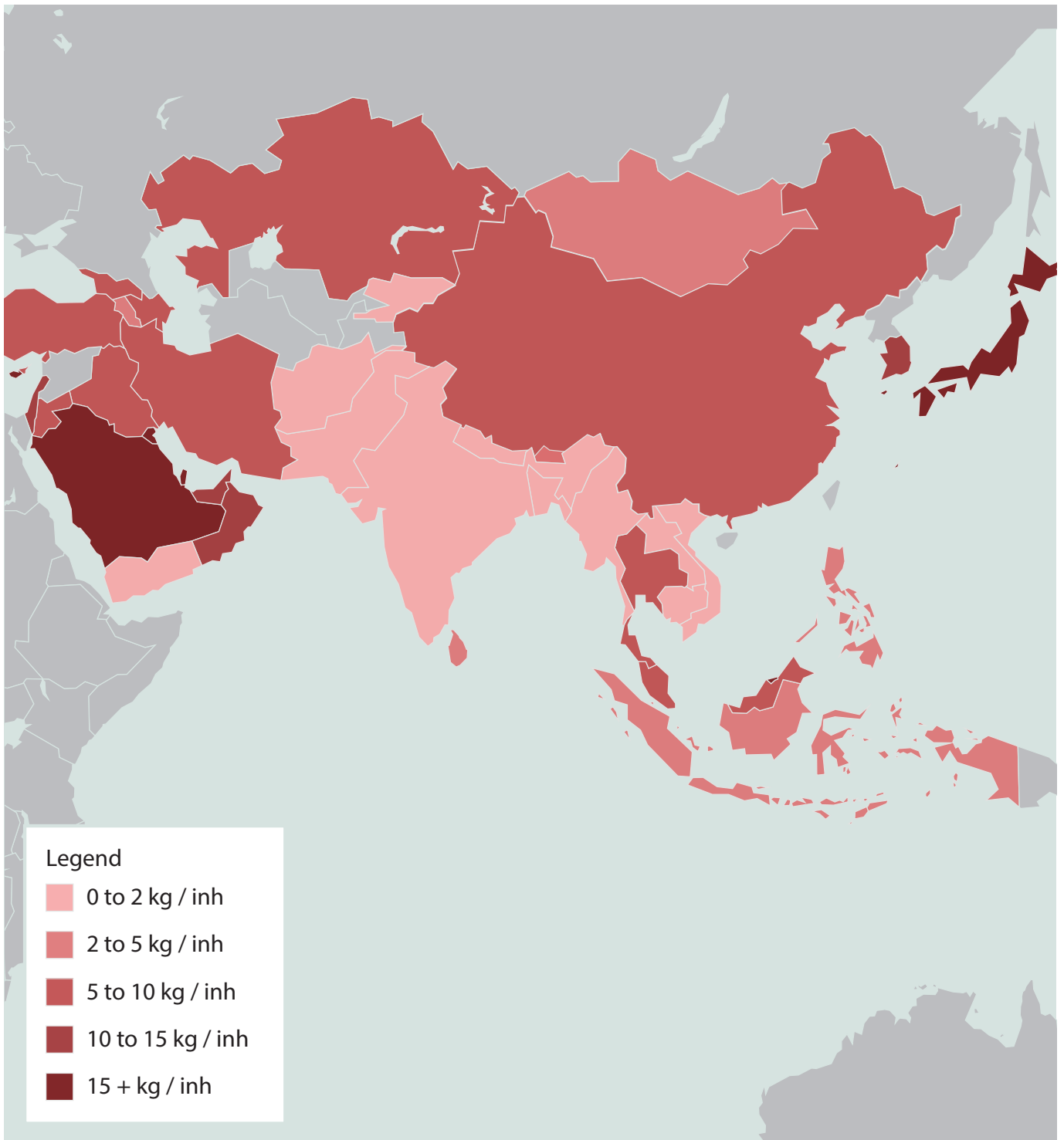
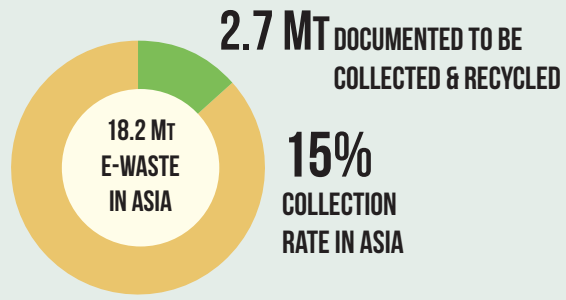
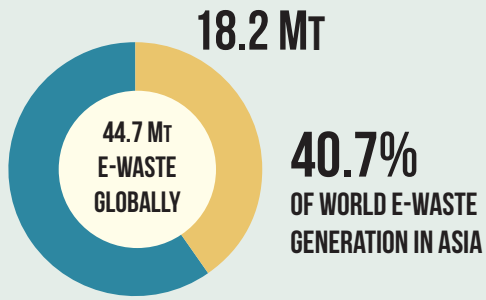
In the Southern and South-Eastern Asia region, India plays an important role in the domestic generation of e-waste (2 Mt in 2016) due to the large population, but the country also imports from developed countries. India's electronics industry is one of the fastest growing industries in the world. The formal e-waste recycling sector in India is currently being developed in major cities. However, informal recycling operations have been in place for a long time, with over 1 million poor people in India involved in manual recycling operations. Most of these people have very low literacy levels with little awareness of the dangers of the operations. Severe health impacts and environmental damage are widespread in India, due to the final step of the e-waste processing by the informal sector. India has had the e-waste rules in effect since 2011. The rule mandates producers to be responsible for the collection and financing of systems according to the Extended Producer Responsibility concept. Further amendment to this rule came in 2015, which resulted in the E-waste (Management) Rule in 2016. The main feature of this rule is EPR. The amended rule has provisions for Producer Responsibility Organisations (PROs) and Deposit Refund Scheme under EPR.

In Cambodia, Sub-decree on Electronic Waste Management was enforced in 2016. Vietnam also had a Prime Ministerial decision on e-waste

49 COUNTRIES
IN ASIA

4.4 BILLION
INHABITANTS

4.2 KG OF E-WASTE
PER INHABITANT



published in 2015, which came into effect in July 2016 and requires that enterprises manufacturing or importing electrical and electronic products to be responsible for collection, transport, and processing of e-waste. So far, Vietnam has not developed an official inventory of e-waste generated in the country. The main issue related to e-waste in Vietnam is the informal recycling activities that are undertaken in Vietnamese craft villages. Transboundary movement is another major issue in Vietnam, and there is no local capacity to deal with the recycling of all the materials in e-waste while using the best available technology. All these factors are effecting the EPR implementation in the country. Sri Lanka currently has no regulations to deal with e-waste specifically. Pakistan currently has no inventory or exact data on e-waste generation, but they have made provisions to prohibit e-waste imports to Pakistan. However, many such items are still being imported to Pakistan as second-hand items (Imran et al. 2017). One of the studies that has attempted to estimate illegal import shows an annual average import of e-waste to Pakistan of around 95,4 kt (mostly computers and related products). Bangladesh currently has no specific Environmental Policy Act or guidelines directly related to managing e-waste. However, Bangladesh has attempted to address this problem. At the moment, no inventory of e-waste in Bangladesh is available. As for end-of-life management of electrical and electronic equipment, reuse is a common practice in Bangladesh. Dismantling and recycling is also a growing business, mainly undertaken by the informal sector. Most of the e-waste in Bangladesh is dumped in open landfills, farming land, and open bodies of water, causing severe health and environmental impacts. A report states that over 50,000 children are involved in the informal e-waste collection and recycling processes, 40% of them in the ship-breaking yards. Every year, around 15% of child workers die as a result of e-waste recycling. Over 83% are exposed to toxic materials in e-waste, become sick, and are forced to live with long term illness. (Environment and Social Development Organisation, 2010). Thailand also suffers from issues such as lack of general awareness about e-waste, incomplete databases and inventories related to e-waste, lack of environmental sound management practices, and lack of specific laws and regulations on e-waste.

Central Asia is currently the only sub-region in Asia where countries still don't have national legislation

enforced on e-waste. In 2016, this sub-region generated an average of 6.4 kg/inh of e-waste, accounting for 154 kt in total; an amount not comparable to the 10.2 Mt generated in Eastern Asia, but there is still an imminent need for its management to be regulated in this sub-region. In Kazakhstan, a project in collaboration with the Ministry of Energy of the Republic of Kazakhstan and the private sector has made proposals to improve the legislative foundation in e-waste management and is helping to improve efficiency of the services for collection, transportation, use, and disposal of e-waste. The questionnaires received from the countries in the sub-region reveal that both legislations and statistics on e-waste have not been defined so far, but they are under development.

Western Asia generates 2 Mt of e-waste. The sub-region includes both high-income countries, such as Qatar and Kuwait, and countries ravaged by wars and conflicts, which cannot rely on a strong legislative framework and on an efficient e-waste management system. Regardless of the economic inequality in the sub-region, only three countries have national legislation in effect (Cyprus, Israel and Turkey). In this area, only the 6% of e-waste is reported to be collected and recycled, mainly by Turkey.

However, governments of some countries in Western Asia are showing increasing interest in adopting solutions to the e-waste problem. Many countries are currently receiving support from other countries or private companies that are interested in the business of e-waste recycling. For instance, in UAE, a facility is being built that will serve as the region's largest centre of expertise for electronic waste management in the Middle East. Expected to commence operations by the end of 2017, Phase 1 of the plant will comprise state-of-the-art equipment to process 39 kt of electronic waste annually.

As a way forward, the policy makers in Asian countries need a well-defined national e-waste management strategy based upon 3R concepts. They should also create enabling conditions for relevant stakeholders and take into account the financial, institutional, political, and social aspects of e-waste management, in particular incorporating the activities of the informal e-waste recycling sector.

Europe

In Europe, the total e-waste generation in 2016 was 12.3 Mt, corresponding to 16.6 kg on average per inhabitant. Germany generated 1.9 Mt in 2016, which is the highest quantity in Europe, Great Britain and Russia generated 1.6 and 1.4 Mt. Norway generates the highest quantity of e-waste per inhabitant in Europe (28.5 kg/inh), followed

by Great Britain and Denmark (each 24.9 kg/inh). Europe, Switzerland, Norway, and Sweden show the most advanced e-waste management practices across the globe. However, other countries are still catching up with Northern Europe, whose collection rate is 49%, the highest in the world.

In the European Union (EU), the e-waste management is regulated uniformly by the WEEE Directive (2012/19/EU). The directive is meant to regulate the collection, recycling, and recovery of e-waste. It includes the provision of national e-waste collection points and processing systems, which enable the proper disposal and treatment of e-waste. This results in a higher quantity of processed e-waste that must be accounted for and reported to the national enforcement authority. The WEEE Directive prescribes that Member States shall encourage the design and production of electrical and electronic equipment, which accounts for and facilitates dismantling and recovery, in particular the reuse and recycling of e-waste, its components, and materials. Member States shall adopt appropriate measures in order to minimise the disposal of e-waste as unsorted municipal waste, and achieve a high level of separate collection of e-waste. The Directive requires Member States to create systems that allow final stakeholders and distributors to return e-waste free of charge. To guarantee environmentally sound treatment of the separately collected e-waste, the E-waste Directive lays down treatment requirements for specific materials and components of e-waste, and for the treatment and storage sites. This legal framework uses the principle of Extended Producer Responsibility, which requires producers to organise and/or finance the collection, treatment, and recycling of their products at end-of-life. Each Member State of the EU, Norway, Switzerland, and Iceland have implemented national legislation in accordance with the intrinsic conditions of the countries.

Since 2016, EU member states have needed to collect 45% of the amount placed on the market, with 65% by 2019, or 85% of the e-waste generated. Reaching these legal targets by 2019 will be very challenging. The official reported numbers by Eurostat have essentially not seen an increase since 2009 and remain about 37% of e-waste

generated. A key issue, researched in-detail in the EU - Countering WEEE Illegal Trade Project¹³, is to capture the tonnage present in multiple complementary flows, including discarding with other wastes ($\approx 10\%$ of waste), complementary non-reported recycling and scavenging of valuable parts and materials ($\approx 40\%$), export for reuse ($\approx 10\%$), and illegal exports ($\approx 5\%$). The most recent country data is provided by the EU - Prospecting Secondary raw materials in the Urban Mine Project¹⁴. This data shows that the best performing countries in Europe, in terms of collection of e-waste, are Switzerland, which collects 74% of the waste generated, Norway (74%), followed by Sweden (69%), Finland and Ireland (each 55%). Ireland and Denmark collect 50% of the waste generated. It should be noted that the denominator of the collection rate are estimations by UNU that have an error of margin of at least $\pm 10\%$ depending on the country, as already mentioned in chapter 5. Therefore, the highest mentioned collection rates indicate that these countries probably collect all or most of the e-waste, and outperform other countries in the world where collection rates are much lower.

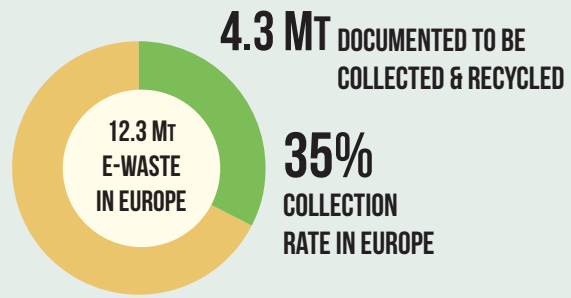
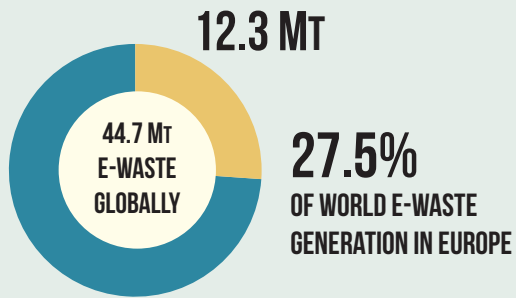
In order to improve the official reported numbers, several countries, including France, Ireland, Portugal and the Netherlands, have been enacting the so-called 'all actors report' model. This includes metal scrap traders, recyclers operating outside the producer compliance programs, refurbishers, and second-hand shops to register volumes.

Another interesting debate relates to Critical Raw Materials in Europe, which are deemed critical to the EU economies. Here, the ProSUM project aims to prospect the amounts, concentrations, and presence of key components, materials, and vital elements to the electronics industry over time. An important ongoing effect is the increased miniaturisation of electronics. Despite a large increase in unit sales of TVs, monitors, laptops, and tablets, the total amount of 'electronics' and, thus gold content, is rapidly declining. From an

40 COUNTRIES
IN EUROPE

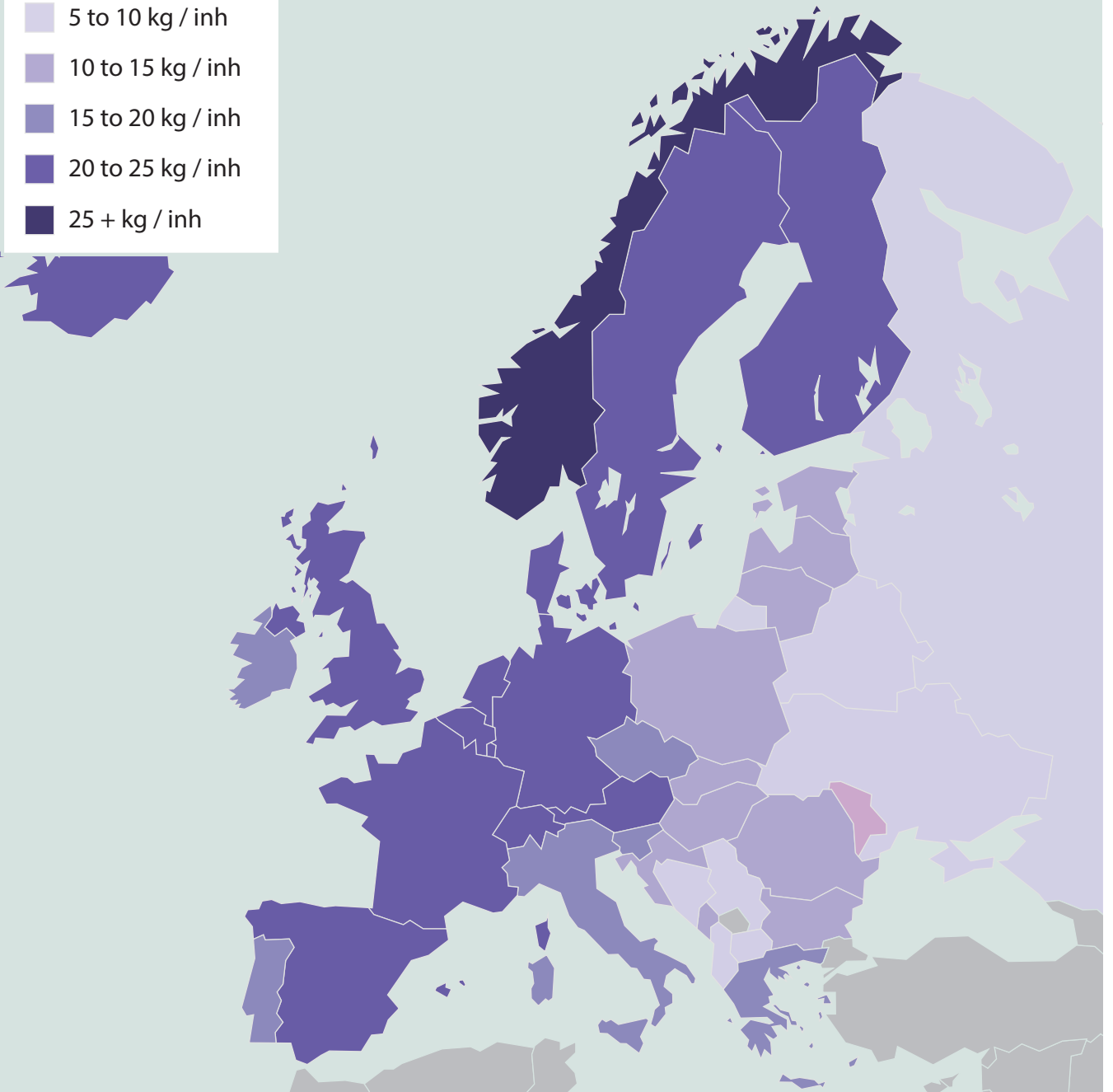
0.7 BILLION
INHABITANTS

16.6 KG OF E-WASTE
PER INHABITANT



Legend

- 0 to 5 kg / inh
- 5 to 10 kg / inh
- 10 to 15 kg / inh
- 15 to 20 kg / inh
- 20 to 25 kg / inh
- 25 + kg / inh



eco-design perspective, this means that more is done with less. However, recovering a larger range of more diluted materials poses future recycling challenges.

The e-waste legislation and knowledge on e-waste management in the Balkan sub-region still needs to be improved. Valid statistical data is still missing, as well as an infrastructure that provides e-waste disposal solutions. The sub-region is currently facing two major problems related to e-waste: most of the e-waste is disposed in landfills, and the current recycling and recovery activities lead to significant resource losses; both cause health and environmental damage. Given the fact that the gaps between the Union and its neighbours to the East, the Southern Caucasus, and the Mediterranean sub-region are worryingly large, the EU established the European Neighbourhood Policy (ENP) in 2003/2004 to align interests in tackling common problems, e-waste being one of them (European Commission, 2007). The ENP Action Plans aim to assist the ENP partner-countries and Russia in addressing environmental concerns. They provide information on EU environment policy and legislation in key policy areas (including the WEEE Directive) and explain how progress can be achieved. In recent years, many initiatives have been carried out and financed by the European Union to improve the legal and institutional framework that enables proper e-waste management in the sub-region. Most of the ongoing projects aim to increase the capacities of the Balkan countries (in particular Macedonia, Serbia, Croatia, and Bulgaria) for lobbying and advocacy concerning e-waste management issues, and to raise awareness about proper e-waste management among citizens, government officials, and the private sector. Thanks to these collaborations, most of the countries in

the Balkans nowadays have national legislation on e-waste in effect (Albania, Bulgaria, Bosnia and Herzegovina, Montenegro, Macedonia, Serbia, and Slovenia). Bulgaria, and Slovenia are members of the EU, and have therefore adopted the WEEE Directive. However, there is still no national legislation tackling e-waste in Kosovo. Although the Balkans sub-region has not implemented an effective e-waste take-back system like the EU Member States, initiatives are undertaken mainly by the private recycling sector. Approximately 158 kilotons (kt) of e-waste is currently collected in the Balkans comparing to the 512 kt generated in 2016. A minimum of 6.5 kg/inh was generated in Bosnia and Herzegovina and a maximum of 16.1 kg/inh in Slovenia.

The disposal structure of e-waste in Eastern European countries such as Russia, Ukraine, and Moldova is not as advanced as in the EU, and e-waste collection and recycling is insufficient despite numerous initiatives by the private sector, which doesn't receive subsidies from the government. In this regard, many initiatives have been started to assist those countries in tackling e-waste, develop ad hoc legislation, and raise awareness. In countries such as Poland, Czech Republic, Hungary, and Bulgaria, collection and recycling are mainly led by the private sector. In the recent years, the collection rate in those countries has risen to approximately 46% of the estimated e-waste generated in 2016. All countries in Eastern Europe, except Moldova, currently have national legislation that regulates e-waste. In 2017, Russia will start an Extended Producer Responsibility (EPR) programme for electrical and electronic scrap. Manufacturers and importers must help collect and process obsolete electronics in line with Russian circular economy legislation.

Oceania

In Oceania, the total e-waste generation was 0.7 Mt in 2016. The top country with the highest e-waste generation in absolute quantities is Australia (0.57 Mt). In 2016, Australia generated 23.6 kg/inh and New Zealand 20.1 kg/inh. Only the Australian government implemented its National Television and Computer Recycling Scheme in 2011. Official data shows that only 7.5% of the e-waste generated

in Australia is documented to be collected and recycled. In New Zealand and the rest of Oceania, the official collection rate is 0%. New Zealand is still in the process of developing a national scheme to deal with the e-waste issue. The e-waste is now mostly landfilled. Across the Pacific Island countries, e-waste management practices are predominantly informal.

Currently, there is only one law on the management of e-waste in Oceania. The National Television and Computer Recycling Scheme is one of the most significant producer responsibility schemes to be implemented in Australia under the Australian Government's Product Stewardship Act 2011. The Act came into effect on 8 August 2011. Under this Act, the Product Stewardship (Televisions and Computers) Regulations 2011 came into effect on 8 November 2011. This scheme provides Australian households and small businesses with access to industry-funded collection and recycling services for televisions and computers. The television and computer industries are required to fund collection and recycling of a proportion of the televisions and computers disposed of in Australia each year, with the aim to increase the rate of recycling of televisions and computers in Australia from an estimated 17% in 2010–11 to 80% by 2021–22 (Australian Government, 2012).

The co-regulatory aspect is a key feature of the above scheme, where the Australian Government, through the Regulations, set the outcomes to be achieved by industry, along with how it is to be implemented. The television and computer industries, operating through the approved co-regulatory arrangements (Producer Responsibility Organisation), will determine how to deliver these outcomes efficiently.

The Australian Government reports that, to date, over 1,800 collection services have been made available to consumers. An estimated total of 122 kilotons (kt) of televisions and computers reached end-of-life in Australia in 2014–15, out of which around 43 kt were recycled (35%) under this scheme. This is a significant improvement from a recycling rate of only 9% in 2008 (Australian Government, 2017).

Compared to Australia, New Zealand is still in the process of developing a national scheme to deal with

the e-waste issue. It is estimated that around 95 kt of e-waste is produced in New Zealand annually, no information is available on the amount of e-waste recycled, which is likely to go into landfills.

In 2014, the Ministry of Environment in New Zealand contracted a private organization to develop a product stewardship framework for managing e-waste in New Zealand. This organization undertook a comprehensive stakeholder engagement and consultation, together with collection and analysis of e-waste data, to develop recommendations for an e-waste stewardship option for New Zealand. It is understood that the New Zealand government is still considering these various options to decide on a particular scheme. They are also closely monitoring the success of the Australian scheme (SLR, 2015).

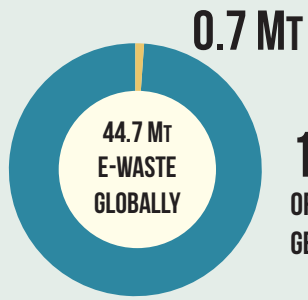
In addition to the above task, the New Zealand government has developed comprehensive guidelines for collection, reuse, and recycling of the waste of electrical and electronic equipment. These guidelines are targeted towards good management of health, safety, and environmental issues when reusing or recycling e-waste (Ministry for the Environment Manatū Mō Te Taiao, 2017).

The Pacific Island sub-region, consisting of 22 countries and territories (PICTs), faces unique challenges due to their geographical spread. The limited availability of suitable land on small islands for constructing landfills, remoteness, relatively small populations are causing issues of economies of scale for waste management technologies. Rapid urbanisation, and limited institutional and human resource capacities are among the key challenges faced by PICTs. Changing weather patterns and rising sea levels compound waste management challenges of PICTs. The waste management in the sub-region is governed by the recently adopted Pacific Regional Waste Pollution Management Strategy 2016-25 (Cleaner Pacific 2025), which

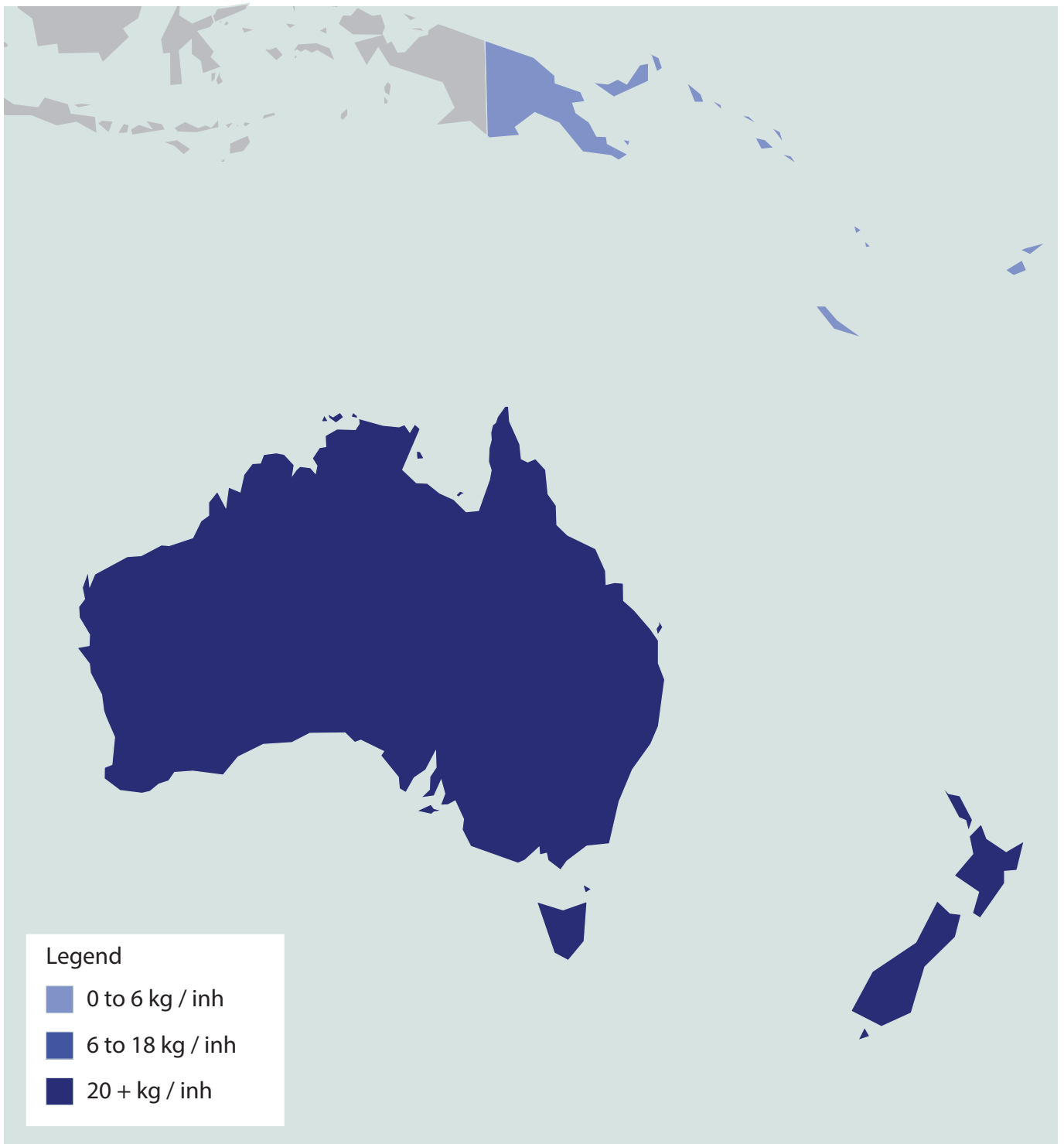
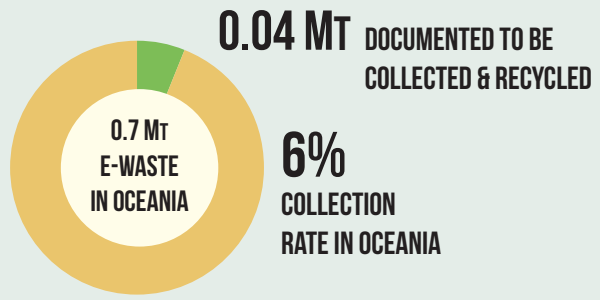
13 COUNTRIES
IN OCEANIA

0.04 BILLION
INHABITANTS

17.3 KG OF E-WASTE
PER INHABITANT



1.6%
OF WORLD E-WASTE
GENERATION IN OCEANIA



details the current situation and the future strategy for managing all the waste streams, including e-waste (SERP, 2016).

Currently in the Pacific, there are significant amounts of e-waste stockpiles awaiting disposal. The efforts to deal with this stockpile face challenges including economic, logistics, limited access to disposal points and recycling markets, and high costs in transporting e-waste out of the sub-region. To find a sustainable solution to the e-waste issues and other hazardous waste streams, the European Union funded a four-year project referred to as the PacWaste (Pacific Hazardous Waste), which is managed by the Secretariat of the Pacific Regional Environment Programme (SPREP) in Samoa. The initial aim of the project is to collect information about current e-waste management practices and

stockpiles across five Pacific island countries in order to prioritize future actions that assist other Pacific islands countries to manage their e-waste stream.

The current e-waste management practices in the sub-region are predominantly informal. Most e-waste is separated at the disposal sites by waste pickers and sold to recyclers. The quantities of e-waste stockpiles in government institutions and commercial establishments are relatively unknown. As far as regulations are concerned, New Caledonia is the only place implementing an Extended Producer Responsibility (EPR) scheme for e-waste. New Caledonia's EPR scheme is managed by a non-profit environmental organisation (TRECOCODEC) that collects e-waste through voluntary drop-off receptacles and from authorised dumps.

